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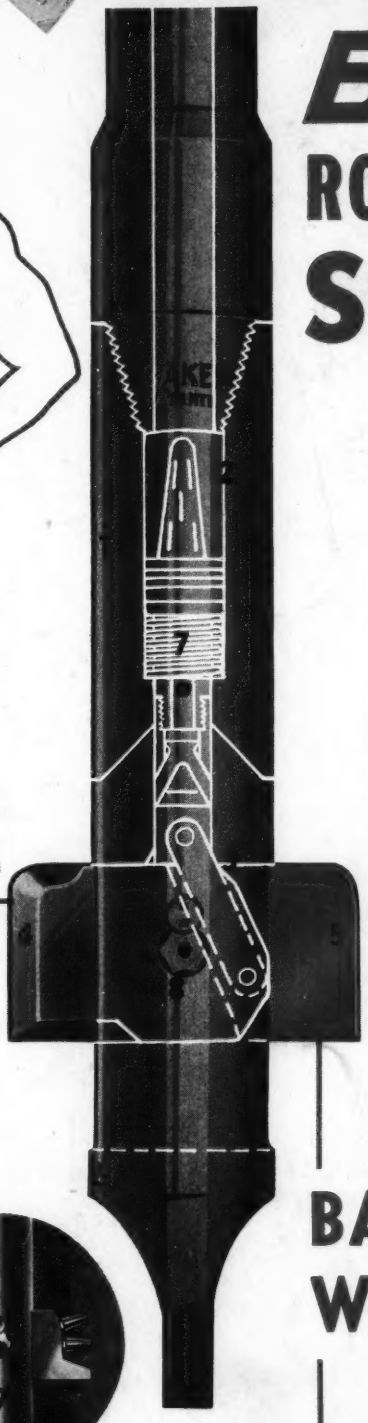
# A TOOL AS STURDY and Dependable AS THE MEN WHO RUN IT

Drilling Crews are a Sturdy, Dependable lot . . . they HAVE to be . . . and they like to work with tools of the same calibre . . . which is one reason why the Baker Wall Scraper is, and ALWAYS HAS BEEN, a top favorite among California oil operators.

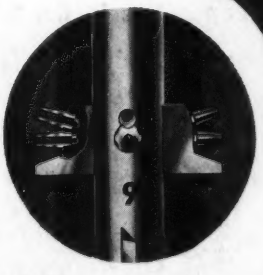


# BAKER ROTARY WALL SCRAPER

Back of every Baker Wall Scraper is a sound, practical knowledge of oil field operations . . . a knowledge that includes an understanding of the important uses to which this tool is put. These factors added to the Service, from factory warehouse to rig floor, that automatically is included in the purchase of every Baker Wall Scraper, results in operators receiving "Plus Value" . . . this Plus Value representing the features of Service that, while not itemized on the purchase order, result in "tool performance" and "customer satisfaction."

**THESE FEATURES ARE RESPONSIBLE FOR ITS SAFETY AND REMARKABLE PERFORMANCE:**

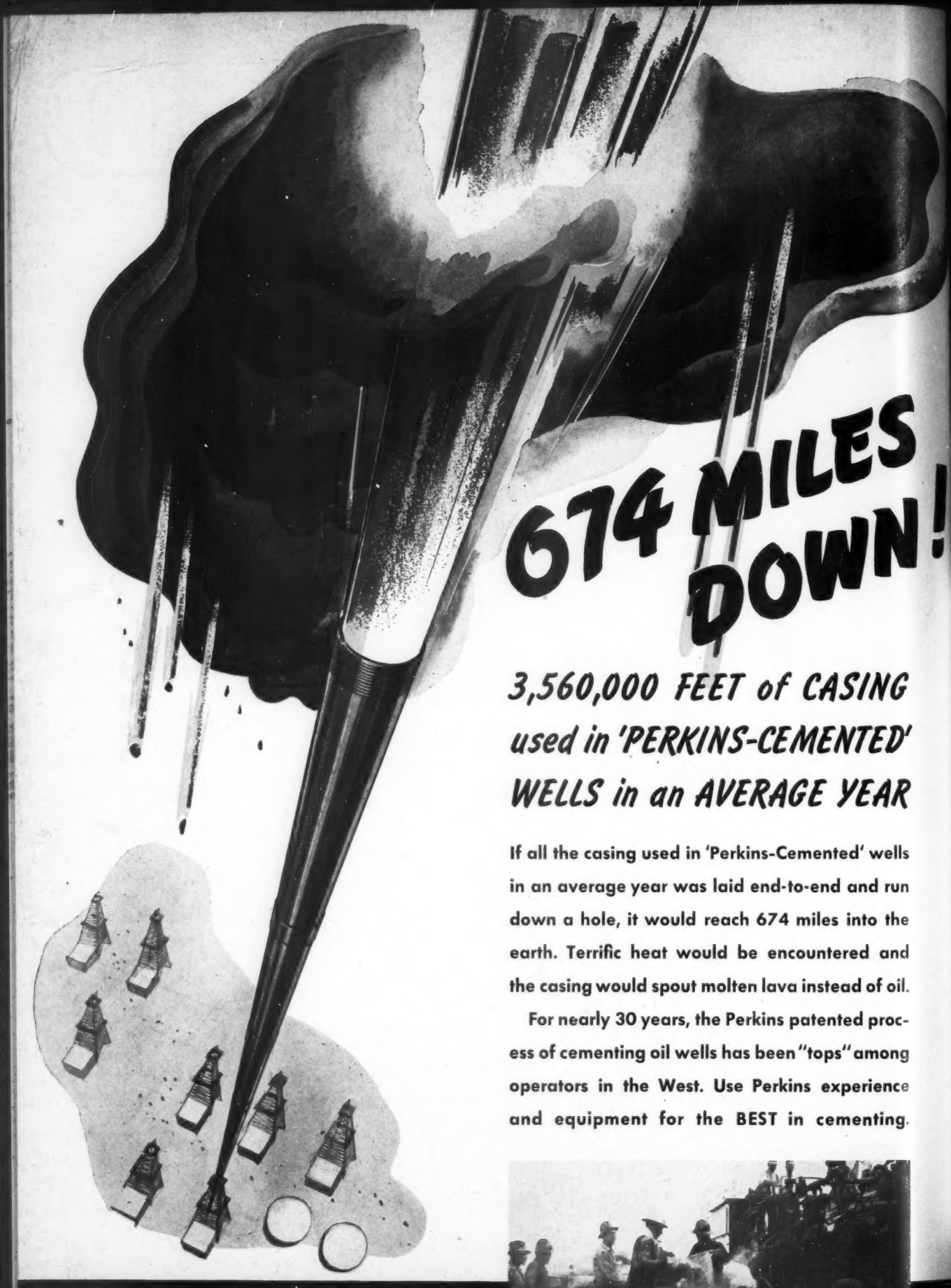
1. Sturdy Construction . . . . withstands USE and EVEN abuse.
2. Correct Design . . . engineered by experienced oil men.
3. Precision Machining . . . where accuracy counts.
4. Long Reaming Surface . . . no corkscrewing.
5. Blades Hard-Faced . . . maximum cutting life.
6. OD same as Tool Joints . . . can't hang up.
7. Positive Blade Opening and Closing . . . safety first and LAST.
8. Steels that Stand up . . . carefully selected for performance.
9. Conversion into a Baker Wall Sampler by Changing Blades . . . an exclusive Baker Feature.



# BAKER ROTARY WALL SCRAPER

*Complete details covering the operation and important applications for the Baker Rotary Wall Scraper are given in Baker Broadcast No. 19 . . . a comprehensive 40-page treatise gladly sent upon request.*

**BAKER OIL TOOLS, INC.**
HUNTINGTON PARK, CALIFORNIA
HOUSTON, TEXAS



# 674 MILES DOWN!

## 3,560,000 FEET of CASING used in 'PERKINS-CEMENTED' WELLS in an AVERAGE YEAR

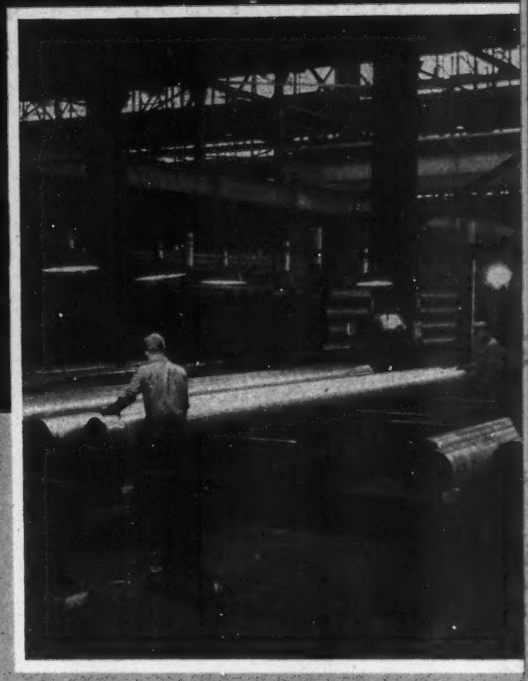
**If all the casing used in 'Perkins-Cemented' wells in an average year was laid end-to-end and run down a hole, it would reach 674 miles into the earth. Terrific heat would be encountered and the casing would spout molten lava instead of oil.**

**For nearly 30 years, the Perkins patented process of cementing oil wells has been "tops" among operators in the West. Use Perkins experience and equipment for the BEST in cementing.**

PERKINS CEMENTING, INC.

342 PETROLEUM SECURITIES BLDG., LOS ANGELES

*FIELD OFFICES:* AVENAL, BAKERSFIELD, NORWALK, SANTA MARIA, TAFT, VENTURA



# *Miles Away, but Members of Your Crew*

MILES from you are thousands of skilled men -- all working *for you* just as surely as is any member of your drilling crew. We are the workmen, inspectors, engineers in the Youngstown Oil Country Tube Mills.

We know our jobs depend on making better pipe for you -- pipe so much better you'll want to specify it.

Some of us spend a good part of the time in the oil fields, checking your needs, coming back to the rest with data on what you want in pipe. That's how we know the trouble that collapse, leakage or a twist-off causes -- and so we use scientific controls in manufacturing pipe, and the most accurate gauges in checking threads.

We know you sometimes use different lots of pipe on the same job. We make this easy by making carefully accurate diameters and absolutely uniform threads.

We know how important uniform walls and lengths are to you. That's why Youngstown built a new seamless tube mill with important new improvements and controls which assure uniformity.

Our jobs depend on pleasing you -- on giving you casing, drill pipe, tubing, line pipe so much easier for you to use, so much better and more dependable, that you'll want to specify them. We may be miles away from you but actually we're working side by side.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon and Alloy Steels

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YOUNGSTOWN

CALIFORNIA
# OIL WORLD
and Petroleum Industry

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April 25, 1939

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# Great Pioneers

## KANSAS 1825

Pioneering prairie commerce to Santa Fe (1825)—the growth of traffic to Salt Lake—and the transcontinental railway explorations made Kansas well known and removed it from that mythical "Great American Desert." Out of these stirring events, which comprise one of the most picturesque chapters of American history, came the ultimate statehood of Kansas, admitted to the Union on January 29, 1861.

● DRIVEN BY THE same venturesome spirit that spurred our pioneers, Dowell developed and perfected the entire process of *Inhibited* Acidizing. Here was a job that oil men thought could not be done—yet, Dowell did it.

This development has recovered millions of barrels of oil and restored profitable production to thousands of stripper wells. It has been followed by Dowell XX—Intensified Acid, Dowell XR—the Sustained Action Acid, Dowell Formation Plug for chemical control of water and gas, Dowell Jelly Seal, and many other advances in oil and gas well chemical service.

Dowell's vast research facilities and technical equipment will develop still more aids to oil production for Dowell continues to be the true pioneer in this vital field.

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Look to

**DOWELL**

OIL AND GAS WELL CHEMICAL SERVICE

# American Petroleum Institute Spring Meet

## Attended by 1000 Oil Men

An attendance of more than 1,000 oil men who evidenced their keen interest in the proceedings by entering actively the discussions marked the outstanding success of another Spring Meeting of the Pacific Coast District, division of production, of the American Petroleum Institute in Los Angeles, April 11. Stender Sweeney, of Richfield Oil Corp., presided at the morning sessions, while Paul Lehr, of Shell Oil Co., Inc., held the chair in the afternoon. At the evening session the presiding officer was Howard C. Pyle, Union Oil Co., who is chairman for the Pacific Coast District.

The Spring Meeting got away to a flying start with the presentation of a safety movie entitled "Foam, Fog, and Snow," by Fred Ledeboer, safety engineer for Shell Oil Co., Inc.

J. E. Brantly, of Drilling and Exploration Co., in a paper entitled "A Preliminary Evaluation of Factors Controlling the Rate of Penetration in Rotary Drilling," presented the results of a survey initiated in 1933 and covering more than 500 well records. The speaker said that prior to 1933 no worthwhile well records existed. The purpose of the survey was largely to ascertain the factors responsible for the increased rate of penetration and to evaluate these factors.

Increase in efficiency of personnel, change in rotating speed, change in fluid volume, and change in weight on bit, were the factors analyzed in the study, and their influence in increasing the rate of penetration were estimated in that order. The rate of penetration, it was found, has increased 120% in the past six years in spite of the fact that many of the wells studied showed no improvement over drilling records of earlier wells. In some areas, Kettleman Hills (brown shale) for instance, the speed of making hole has increased as much as 385%.

Howard C. Pyle
Chairman of the Pacific Coast A.P.I. Production Division.

R. W. French
Showed Importance of Well Temperature Records.

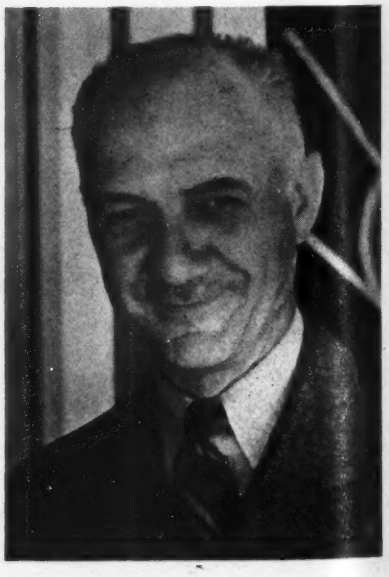
F. W. C. Ledeboer
Gave Safety Lessons on the Movie Screen.

The estimated parts played by the drilling factors considered were given as follows: increase in personnel efficiency, 55.5%; increase in rotating speed, 39.6%; and increase in fluid volume, 28.6%. The factor of weight on the bit proved the most difficult to evaluate, critical limits being found in different formations. In approaching optimum drilling conditions, personnel efficiency would control in obtaining the proper distribution of the rotating speed, weight on bit, and fluid volume factors.

Within certain limits, the speed of penetration increased 108% for each 33.3% increase in speed of the rotary table. Net increase for increased R.P.M. was found to be 39%. Under the test conditions the speed of penetration increased 28% for each increment of 200 G.P.M. in fluid volume. These improvements were noted within the limiting factors controlling the drilling of a well with a deviation from the vertical of not more than 3%.

In certain formations, notably the extremely hard formations, the curve on increased penetration with increased rotary speed reversed its trend at a point not much over 100 R.P.M. In all cases the strength of bit and drill pipe set a limit to rotative speed and weight on bit. The type of formation ruled importantly in selection of proper fluid volume.

John F. Dodge, professor of petroleum engineering, University of Southern



J. E. Brantly
Analyzed Drilling Speed Increase Factors

F. W. Hertel
Vice chairman for the A.P.I. Coastal area, Ventura.

California, warned that he was "sticking his neck out" in presenting his paper on the "Economics of Deep Drilling in the San Joaquin Valley". That he knew what to expect was demonstrated immediately after his closing remarks when several leading oil company petroleum engineers presented conflicting data. Particular targets of speakers who followed were the statements included in the following quotation:

"The rod pump, used in production operations from the beginning of the industry apparently has reached the limit of its applicability in the present deep producing wells in the Los Angeles Basin fields. Even with improved rod steel, heat treated, there is a definite practical limit to the depth at which a reciprocating pump can be operated by a string of rods from the surface and it is believed that the present 7,500 foot pumping well represents that limit. Similarly the straight gas lift, in the writer's opinion, has reached a depth limit in the same wells, due partly to mechanical difficulties, partly to economic conditions caused by operating costs and partly to high back pressures on the formation, difficult if not impossible to avoid in deep wells with low fluid levels. Intermittent gas lifts, electrically operated deep well pumps and hydraulic plunger pumps have been and are being used in an attempt to recover at a profit the substantial amount of oil left in the formation at the end of the well's flowing life, but to date little hope can be offered that the profit from such operation's will form any appreciable addition to the profits derived from operations during the well's flowing period. " . . . . . Intermittent gas lift devices, of the type making use of a packer on the tubing, are of questionable application since extrapolation of field data

Oliver Scott Thompson
Vocational Education for the Oil Worker.

made available to the writer by a major oil company would seem to indicate definitely that at 8,000 feet the back pressure on the formation with such a device would equal or exceed that necessary to operate a straight gas lift. The intermittent chamber displacement pump with macaroni string of tubing is not open to the same objection and although never used at such a depth to the writer's knowledge, theoretically should be applicable with some success. Hydraulic plunger pumps, particularly if used as a stage lift followed by straight gas lift are also theoretically applicable and may offer the greatest possibilities, particularly in wells with exceedingly low gas oil ratio . . . . "

Prof. John F. Dodge
Spoke on Economics of Deep Drilling, San Joaquin Valley.

F. R. Schmieder
Vice chairman for the A.P.I. Basin area, Los Angeles.

In his paper on "Geothermal Gradients in California Oil Wells," R. W. French, of Continental Oil Co., said that a knowledge of subsurface temperatures is vital in reservoir content studies and space volume relations. By use of temperature data, he said, it is sometimes possible to make geological correlation with structure, as well as to detect faults. Possibilities exist for detecting or observing subterranean water movement, based on transient temperatures in wells. Mud performance and stability in drilling wells is affected by heat. Chemical treatment of wells in cleaning out, or plugging water sands may be affected by heat.

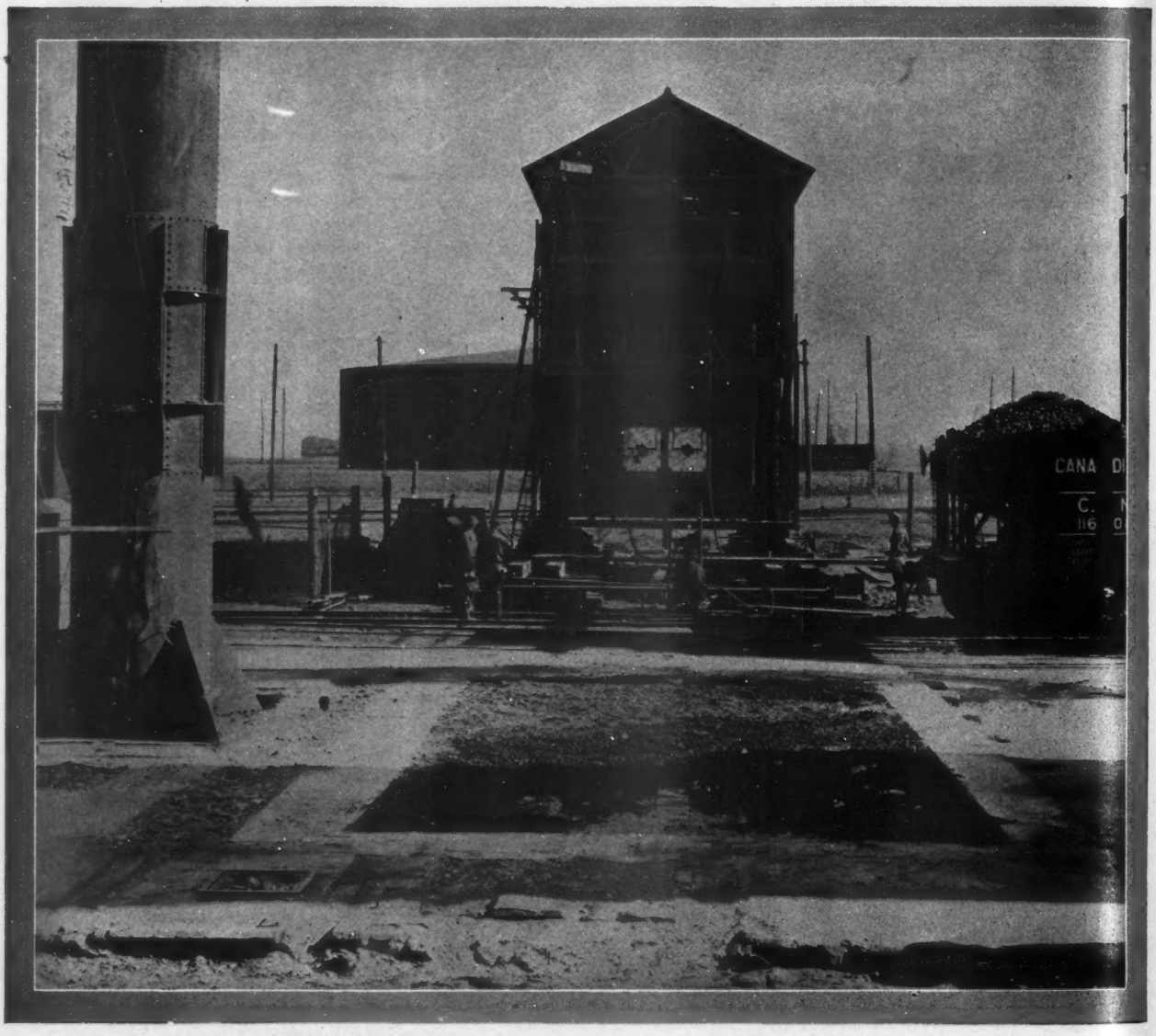
Selection and application of cement as well as calculation of safe drilling-out time, Mr. French said, should be based on accurate temperature data. Design of tools, instruments, and materials for use in drilling or producing wells must recognize temperature conditions which may be critical in some instances, he said. Thermodynamic analysis of flow tube design and the use of phase-equilibria tables require detailed temperature observations. Temperature surveys, he said, are accepted for the location of freshly placed cement outside casing, and in scattered instances, have logged formations behind casing, detected water sources both in open and

# REPLACING AN OBSOLETE HEATER

## WITH A LUMMUS

## 30,000,000 B. T. U. UNIT...

# IN 9 DAYS FROM STREAM TO STREAM



*To reduce shutdown time, this Lummus Heater was built in an open space behind the existing heater. When completed it was moved to the site of the old heater.*

*Moving the Lummus Heater, weighing 125 tons, across railroad tracks.*

*The Lummus Heater in place on the old site. Note the difficulties imposed by the stack and tower between which the new heater had to be placed.*

The British American Oil Company was faced with the problem of replacing an obsolete oil heater that was beyond repair, without shutting down the entire plant for the eight to ten weeks normally required to dismantle an old heater, clear the site and erect a new heater.

Engineers of British American chose the Lummus Heater for its adaptability to erection on a temporary site and to movement on to the existing foundations after the old super-structure was removed.

Impracticable as this idea would have been with a conventional type heater, it was perfectly feasible with the Lummus Heater, with its light weight setting, its insulating firebrick tied back to the steel frame work, its hearth above ground and other Lummus features.

In a space 60 feet behind the old heater, a standard Lummus 30,000,000 B.T.U. heater was erected, identical in design and construction with heaters of similar capacity installed under conventional conditions, except for the addition of rails under the columns to facilitate movement.

The new heater was assembled on a timber mat by the regular maintenance crew of the plant in conjunction with their normal maintenance work.

—At 7:00 p.m., September 12th, the fires were cut on the old furnace.

—by noon, September 15th, the old furnace had been removed and the foundation cleared for the new heater.

—by noon, September 19th, the Lummus Heater had been moved into position and grouted in on the existing foundation.

—by 2:30 p.m., September 21st, the Lummus Heater, containing 50 tubes and headers that were salvaged from the old furnace, had been connected to the oil lines and stack, tested out and the fires lighted.

—At 7:00 p.m., just nine days after cutting the fires on the old furnace, the new Lummus Heater was on stream. Lummus heater construction avoids the necessity for prolonged periods of slow firing to cure the setting.

Lummus Oil Heaters, even in the larger capacities are virtually mobile units. They can be erected in the field and moved to an old site. If necessary they can be moved again to another part of the refinery.

If you are operating under the handicap of an inadequate or inefficient heater, Lummus engineers will be glad to study your conditions and work out with you the installation of a modern, Lummus Heater with the minimum interference with operation.

**THE LUMMUS COMPANY, 420 Lexington Avenue, NEW YORK, N. Y.**

**600 SOUTH MICHIGAN AVENUE, CHICAGO, ILL. • 411 WEST FIFTH STREET, LOS ANGELES, CAL. • BUSH HOUSE, ALDWYCH, LONDON, W. C. 2**

# LUMMUS

## PETROLEUM REFINING PLANTS

**OPERATING COSTS OF INDIVIDUAL WELLS WHICH ARE GRAVEL PACKED AND CONVENTIONAL WELLS ADJACENT THERETO FOR THE YEAR 1938—SAN JOAQUIN VALLEY DISTRICT**

| Well | Pulling and Bailing Cost | Pump Repair Cost | Total Cost | Total Bbls. Produced in Period | Average Cost/ Bbl./$, Bbl. |
|---|---|---|---|---|---|
| **Conventional Wells—West Side Group** | | | | | |
| 1 | $ 360.00 | $ 200.00 | $ 560.00 | 0 | |
| 2 | 1,607.85 | 891.97 | 2,499.82 | 92,987 | |
| 3 | 384.25 | 514.78 | 879.03 | 79,456 | |
| 4 | 1,213.35 | 425.77 | 1,639.12 | 17,016 | |
| 5 | 515.20 | 48.61 | 563.81 | 23,271 | |
| Total | $4,060.65 | $2,081.13 | $6,141.78 | 212,730 | 35 $0.029 |
| **Gravel Packed Wells** | | | | | |
| 1 | $ 590.20 | $ 318.58 | $ 908.78 | 36,407 | |
| 2 | 383.10 | 190.31 | 573.41 | 66,812 | |
| 3 | 390.55 | 393.07 | 783.62 | 94,771 | |
| 4 | 841.55 | 407.44 | 1,248.99 | 31,622 | |
| 5 | 632.50 | 360.33 | 992.83 | 85,046 | |
| 6 | 242.85 | 29.03 | 271.88 | 92,537 | |
| 7 | 99.40 | 8.35 | 107.75 | 46,442 | |
| 8 | 21.40 | 197.19 | 218.59 | 26,768 | |
| 9 | 357.20 | 195.31 | 552.51 | 29,290 | |
| 10 | 537.85 | 97.85 | 635.70 | 60,910 | |
| 11 | 834.45 | 3.72 | 838.17 | 42,482 | |
| Total | $4,931.05 | $2,201.18 | $7,132.23 | 613,087 | 86 $0.012 |
| **Conventional Wells—East Side Group** | | | | | |
| 1 | $ 422.50 | $ 125.71 | $ 548.21 | 15,717 | |
| 2 | 24.00 | ..... | 24.00 | 8,567 | |
| 3 | 71.90 | 44.04 | 115.94 | 18,912 | |
| 4 | 207.85 | 3.48 | 211.33 | 15,768 | |
| 5 | 837.73 | 109.30 | 947.03 | 8,429 | |
| 6 | 189.93 | ..... | 189.93 | 3,368 | |
| 7 | 22.00 | ..... | 22.00 | 8,069 | |
| 8 | 143.00 | 89.42 | 232.42 | 4,973 | |
| Total | $1,918.91 | $ 371.95 | $2,290.86 | 83,803 | 37 $0.027 |
| **Gravel Packed Wells** | | | | | |
| 1 | $ 385.23 | $..... | $ 385.23 | 20,642 | |
| 2 | 76.85 | 227.01 | 303.86 | 19,940 | |
| 3 | 84.85 | 45.82 | 130.67 | 20,678 | |
| 4 | 363.55 | ..... | 363.55 | 16,597 | |
| 5 | 26.00 | ..... | 26.00 | 13,886 | |
| Total | $ 936.48 | $ 272.83 | $1,209.31 | 91,743 | 76 $0.013 |
| **Conventional Wells—Northerly Group** | | | | | |
| 1 | $ 989.15 | $ 81.13 | $1,070.28 | 10,519 | 9.9 $0.10 |
| **Gravel Packed Wells** | | | | | |
| 1 | $ 724.55 | $..... | $ 724.55 | 4,231 | |
| 2 | 377.90 | 98.15 | 476.05 | 4,142 | |
| 3 | 278.45 | 67.31 | 345.76 | 7,090 | |
| 4 | 332.65 | 129.18 | 461.83 | 45,389 | |
| Total | $1,713.55 | $ 294.64 | $2,008.19 | 60,852 | 30 $0.033 |

cased hole, and located gas or oil producing horizon in open hole.

William A. Clark, of The Texas Co., discussed the "Economics of Gravel Packing in California." The presentation was described as a progress report covering the performance of gravel-packed wells in certain areas having the oldest histories of gravel packing, dealing with actual well performance and costs rather than theory.

The writer said that there may be several reasons for the greater production of gravel-packed wells over conventionally completed wells. Among these reasons he listed the following: The gravel-packed wells may pump for long periods before pulling, while the conventional wells during that time are gradually filling with sand, or the sand is wearing out the pump, reducing output for several days or weeks. When the latter well is pulled, additional down time occurs, further reducing the month's total production from the conventional well.

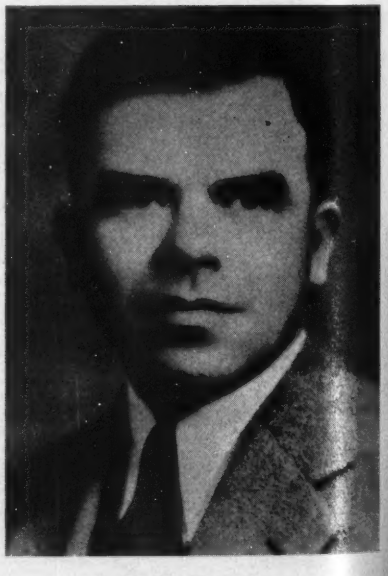
Better pump efficiencies in gravel-packed wells on account of inserting the pump deep within the liner in the gravel-packed wells, a practice that is hazardous on account of sanding-up in conventional wells. Possibly improved productive efficiencies from the zone due to the large diameter hole in the gravel-packed wells. In the West Side area of the San Joaquin Valley, an expanding gas cap and lowering fluid level has made pumping a difficult matter, the writer said, due to gas lock and heaving in conventional wells when the fluid level has approached the top of the zone. In the gravel-packed wells very little trouble is encountered from these causes; the gravel preventing heaving and appearing to act in part as a gas separator.

Col. Ernest O. Thompson
Avert Political Control by Adopting Compact, He Urges.

Ernest K. Parks, consulting petroleum engineer, Los Angeles, discussed the organization, activities and accomplishment of the A.P.I. Division of Production. The organization chart is presented in these columns. At the close of his presentation, Mr. Parks introduced Carl A. Young, A.P.I. executive particularly known for his outstanding work on standardization. Mr. Young told those present that the work of standardization was one of continuous advances and cited some drastic changes which are coming in the A.P.I. pipe and thread standards.

The growing applications for a newly discovered metal in the oil industry was discussed by Otto Hammer, chief engineer for Security Engineering Co. The paper, entitled "Applications of Drillable Material for Well Completions and Repair Work," appears in full elsewhere in this issue of the California Oil World.

Frank E. O'Neill, Oil Field Service Co., discussed "Improvements in Formation Testing," in a comprehensively illustrated and detailed presentation. The writer covered the design of the various present day commercial testers in use in the oil fields of California and some of the testers in use in the Mid-Continent. An attempt was made to classify these tools according to the direction of motion required to open and close the retaining valves. The customary circulating valve was explained briefly along with the use and the precautions necessary to successful testing when this valve



Ernest K. Parks
Spoke on Organization, Activities, of A.P.I.

# Properly Conditioned MUDS ARE ESSENTIAL TO FAST DEEP DRILLING

## CONTINENTAL OIL CO. SETS AND CEMENTS 12020 FEET OF CASING IN 8 HOURS, 35 MINUTES

### A NEW CASING RECORD

Started running in casing at 6:00 A.M. February 12, 1939. • On bottom at 1:02 P.M. Time...7 hours and 2 minutes. • Cementing Time...1 hour and 33 minutes. • Total Time...8 hours, 35 minutes.

### CASING SET

| | |
|---|---|
| 2816 Feet . . . . . | 30 lb. 7 inch O. D. Streamline (on bottom) |
| 6971 Feet . . . . . | 28 lb. 7 inch O. D. Streamline |
| 2224 Feet . . . . . | 26 lb. 7 inch O. D. Streamline |
| 9 Feet . . . . . | Nipple |
| 12020 Feet | Total length of casing. |

12020 FEET

A NEW CASING RECORD has been added to the rapidly increasing list of peak performances achieved by modern drillers . . . this time by the Continental Oil Company on KCL-A4-8 in California. The amazing speed of 7 hours. 2 minutes to run 12020 feet of 7 inch O. D. casing seems incredible. An additional hour and 33 minutes to cement this string made a total of 8 hours and 35 minutes for the complete job. Besides the efficient team-work of the crew, it is obvious that the hole had to be in perfect condition.

Operators are realizing more and more that the type of mud used in drilling is one of the most important factors in enabling drillers in many fields to carry many feet of open hole—as much as 11,000 feet—and to run in casing easily and successfully.

We are pleased that BAROID was selected for use in KCL-A4-8. The mud weighed 97.8 lbs. per cu. foot (13.07 lbs. per gallon); viscosity was 48 seconds (1500/1000); water loss as tested on 100 lb. 3-inch tester, 13.5 cc. in 1 hour. Cake thickness was 4/32 inch.

Baroid Products, in thousands of wells, have helped make drilling safer, faster and more economical.

### FIELD SERVICE CARS
**AVAILABLE IN ALL ACTIVE OIL FIELDS**

Laboratory-equipped Baroid Service Cars, in charge of competent field Service Engineers trained in helping to solve drilling mud problems, are available to producers in all active oil fields of the United States. Tests and complete analyses of your drilling mud problems will be made right at the well at anytime on request, and without obligation.

### BAROID PRODUCTS

BAROID—Extra-Heavy Drilling Mud. • AQUAGEL—Trouble-Proof Colloidal Drilling Mud. • STABILITE—An Improved Chemical Mud Thinner. • BAROCO—An Economical, Salt Water-Resisting Drilling Clay. • FIBROTEX—For Preventing or Regaining Lost Circulation. • DISPERSO—for reconditioning cement-cut muds. • AQUAGEL for CEMENTING EQUIPMENT—for setting casing and restoring lost circulation. • TESTING EQUIPMENT—for drilling mud analysis and control.

Stocks carried and service engineers available in all active oil fields. Look for this trade mark under "Oil Well Drilling Muds" in your classified telephone directory for our nearest service engineer and distributor.

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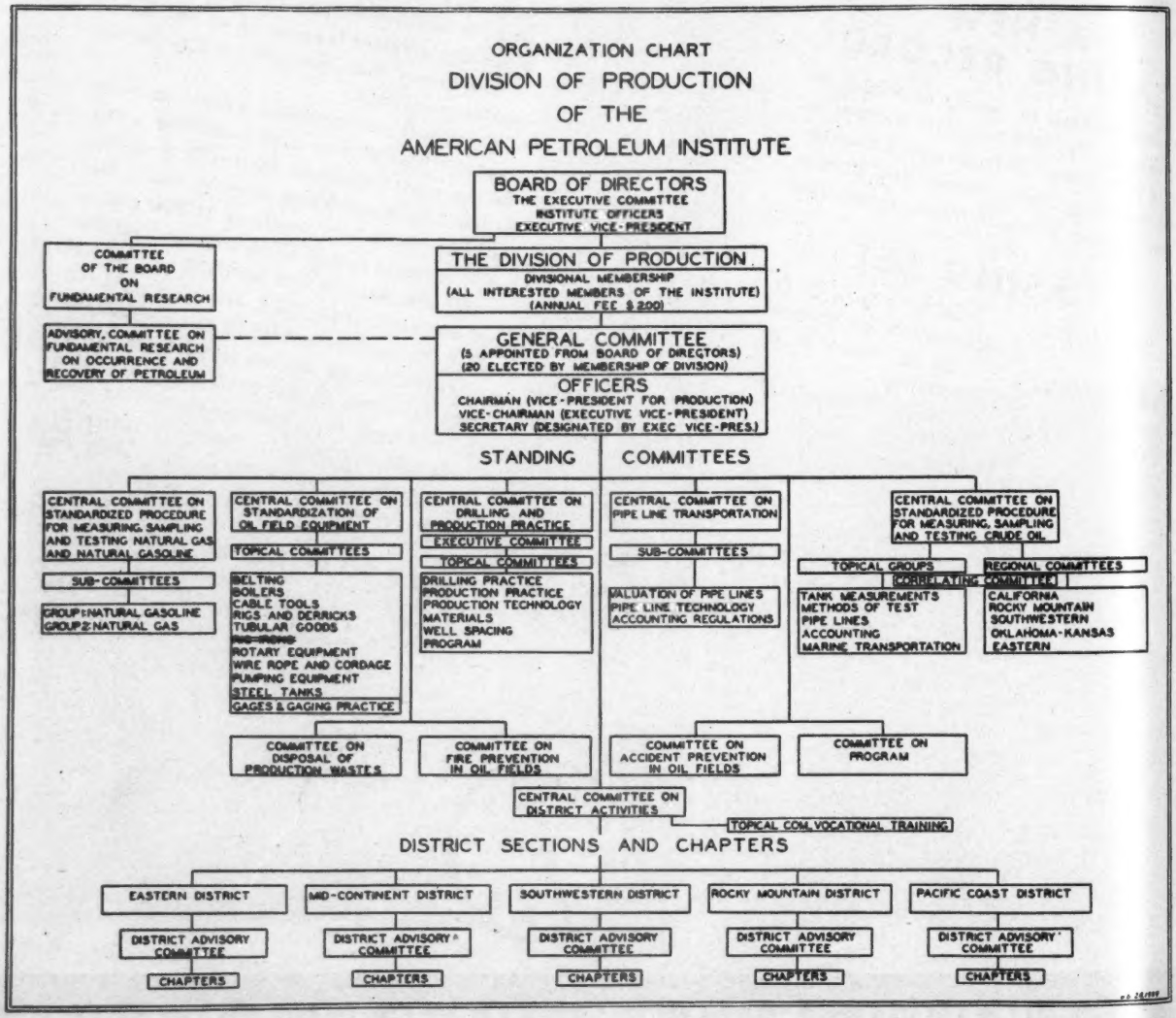
Paul Lehr
Presiding officer at the afternoon session.

is used. The length of the strainer pipe on the bottom of the tool was discussed and points for and against the long strainers were considered. Some consideration was also given to the material from which these strainers are made, and to the safety precautions suggested with long strainers.

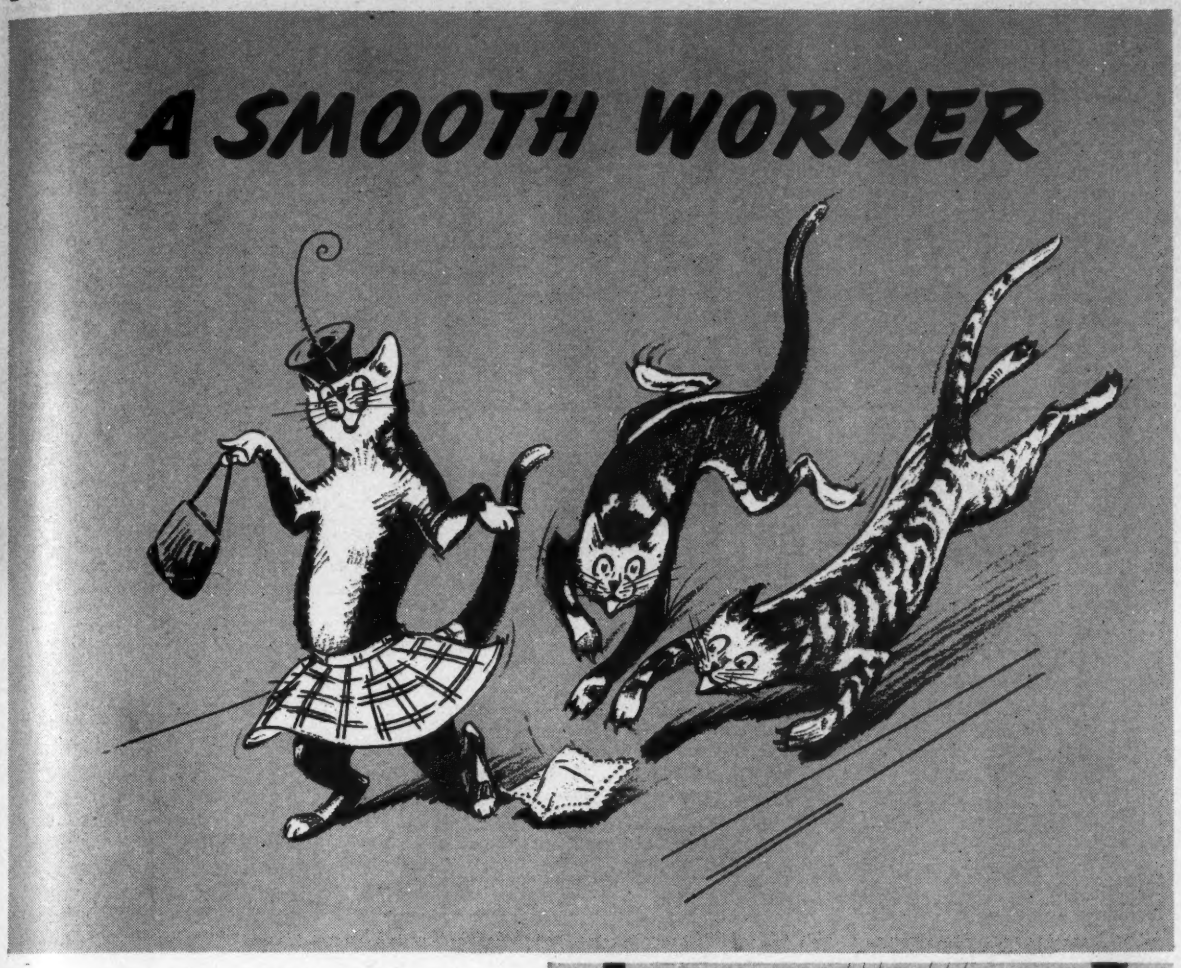
The discussion also covered the various types of commercial packers and their improvements. The use of the rotary jar as an adjunct to testing was touched upon briefly. The locking type of equalizing valve, its uses and advantages, and the uses and advantages of the depth pressure recorder were discussed. An attempt was made to classify depth pressure recorders as to the actuating element. Notes and precautions applicable to the string of testing tools, the surface equipment, and the preparation of the well to be tested were offered.

O. Scott Thompson, president of Compton Junior College, spoke on "What Trade Extension Classes Should Mean to the Oil Worker". The speaker

Stender Sweeney
Presiding officer at the morning session.



ELECTRICITY AT WORK IN THE OIL FIELDS




The smooth, even motion of an electric motor is considerably easier on the pump than the variable, often jerky power supplied by other prime movers. With an electric motor, the speed of the pump stroke never varies whether the flow is light or heavy—there are no sudden, dangerous strains or jerks on the sucker rod.

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abstracted his discussion in the following words: "Trade extension classes are offered in order to increase the skill and knowledge of the workers in their daily occupations or to lead to promotions or advancement. The world has changed largely due to the application of science. This is particularly true in the petroleum industry where science has brought about so many changes and improvements. Workers who expect to keep up with this industry must be trained so that they may understand the developments and will be able to make the greatest use of them. Worker's age is no bar to learning and investigation at some of the leading universities has shown that an adult can learn as thoroughly as youth, although it may take a little more time."

Col. Ernest O. Thompson, chairman of the Interstate Oil Compact Commission and member of the Railroad Commission of Texas, was the guest of honor at the banquet which closed the Spring Meeting. The Colonel spoke on the evolution of proration. "Very fast have we progressed in this effort to prevent waste in the production of oil and gas," the speaker said: The oil compact was described as the only means of averting control by state or federal political groups or bureaus.

Frank A. Morgan
Chairman of the Spring Meeting
A.P.I. Program Committee.


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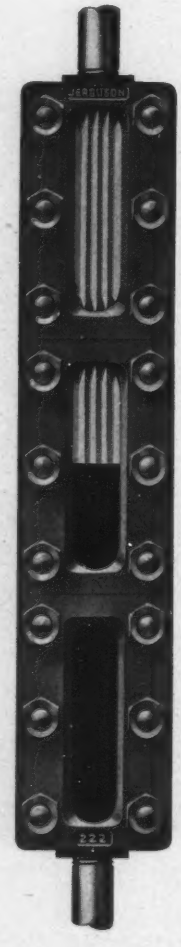

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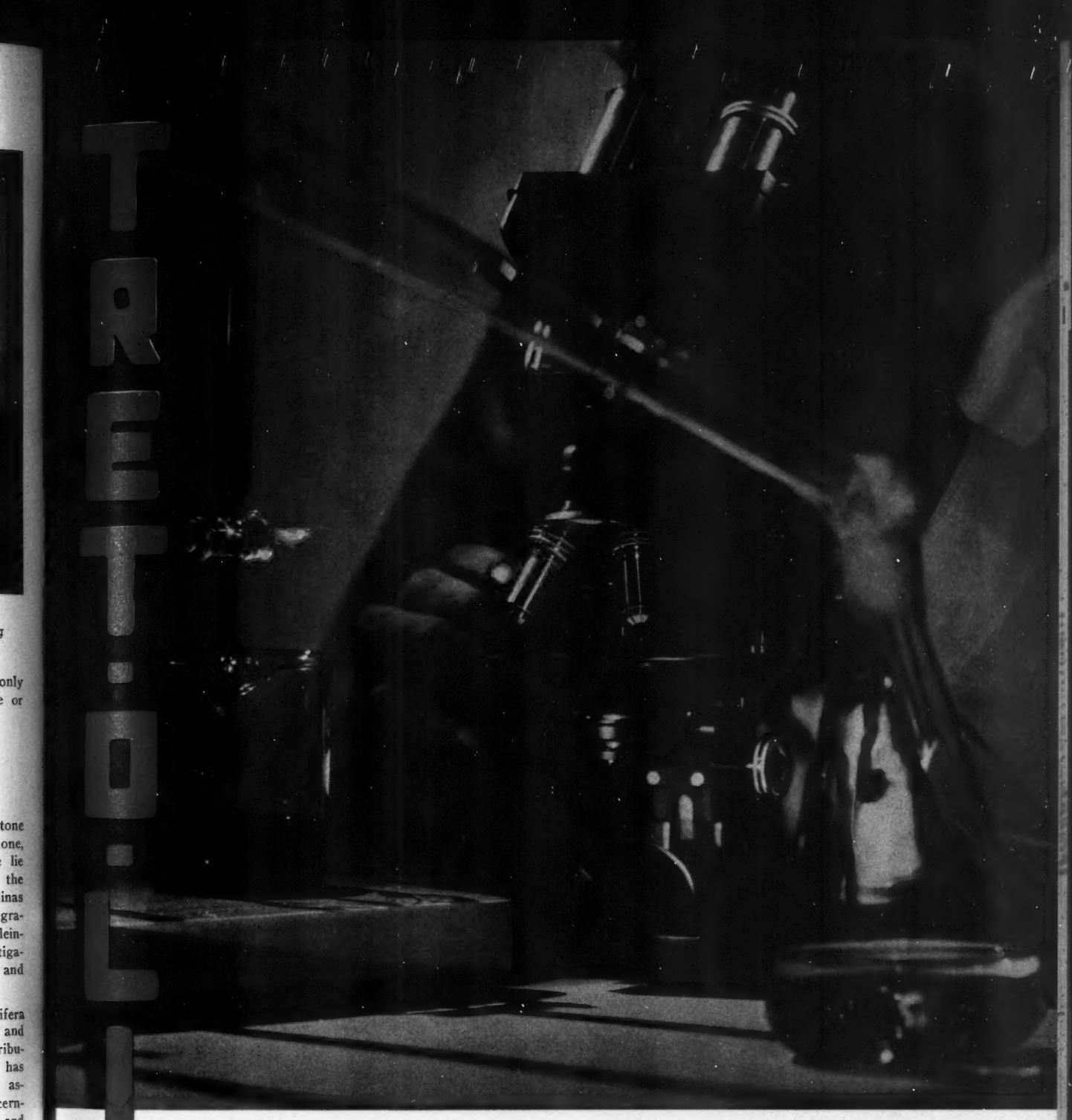
## Book Discusses Miocene Stratigraphy

Separating the Vaqueros sandstone from the Santa Margarita sandstone, about 6000 feet of Monterey shale lie along Reliz Creek, a tributary of the Arroyo Seco, on the west side of Salinas Valley, California. "Miocene Stratigraphy of California," by Robert M. Kleinpell, discusses paleontological investigation in Reliz Canyon by the author and others.

In addition to figuring the foraminifera from Reliz Canyon and recording and discussing their stratigraphic distribution in this section, Mr. Kleinpell has tried to ascertain from the faunal assemblages as much as possible concerning the geologic history of the area and the age of the strata in which the fossils are found. In order to decipher the geologic history, the literature dealing with the living forms most closely related to these fossil foraminifers was surveyed; the information so compiled is summarized in the book in a section dealing with the paleogeographic significance of the Reliz Canyon assemblages. The discussion of the age relations of the faunules necessitated a review of the published data on Miocene foraminifera of California, for the Reliz Canyon section includes strata ranging in age throughout the Miocene.

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# Applications of Drillable Material

## For Well Completions and Repair Work

by
O. Hammer
Security Engineering Co., Inc.
Whittier, California

**ABSTRACT**

Mechanical limitations sometimes are the important factors which determine production methods. Drillable materials permit well completion technique to be widely varied to meet certain present or future production requirements. The nature of subsurface oil well work necessitates the use of materials sufficiently strong to satisfy handling and service requirements; withstand erosive action of fluids and resist corrosion. Furthermore, the material must be readily drillable, possess a low specific gravity and form bit cuttings which can be circulated from the well.

Oil well completion technique varies in many producing localities in accordance with the exact requirements of the particular productive strata. However, in any well, mechanical limitations sometimes are the prime factors which determine the production methods to be used. Increased flexibility of well completion technique would, therefore, be an aid in permitting these methods to be varied to meet specific present or unforeseen future production requirements. A step towards this desired increased flexibility has been found in the adaptation of the properties of an alloy. It possesses ample strength for subsurface use but has the distinction of being readily drillable which allows it to be removed from the well by means of a drilling bit. This material is available in the various pipe and tubing sizes as well as in the form of heavy wall extrusions, forgings, bar stock and castings. The characteristic of drillability in combination with the various forms of fabrication allow devices to be used with a certainty that the metal can be removed at any time desired and those sections of the well where drillable materials exist can be returned to their original state without loss of hole or pipe diameters.

A drillable metal should possess certain properties for underground oil well production installations: namely, 1, be sufficiently strong to satisfy normal handling and service requirements; 2, be able to withstand erosive action of certain types of sand laden fluids; and 3, be able to comparatively resist attack of corrosive substances. In addition to these, the material should have a low specific gravity and form small chip-like cuttings when drilled so that the bit cuttings can be carried from the well by the return circulation fluid.

Presented at the Spring Meeting of the Pacific Coast District A. P. I. Division of Production, Los Angeles, California, April 11, 1939.

Otto Hammer
Spoke on Application of Drillable Materials.

The minimum mechanical and physical properties of a widely used drillable metal are as follows:

| | |
|---|---|
| Ultimate Strength | 38,000 p.i.2 Min. |
| Yield Strength | 32,000 p.i.2 Min. |
| Shear Strength | 26,000 p.i.2 Min. |
| Elongation (% in 2 ins.) | 20 |
| Specific Gravity | 2.69 |
| Weight in pounds per cubic inch | .097 |
| Modulus of Elasticity | 10,300,000 |

The application of drillable metal to production work varies with the particular field or well problem and the methods and procedure discussed herein can be expanded or modified for adaption to specific requirements.

The most widely used applications are for regular production liners or screens which are perforated, run and set in any conventional manner. Adapters, liner hangers, packers and other fittings are made of drillable materials so that the entire assembly is subject to removal with a drilling bit. Many of these installations consist of placing the largest diameter liner possible through the same size casing since "wash-over" space is not required and the benefits of larger screening areas are obtained. These regular production liners are sometimes modified to combine drillable pipe with steel pipe to form a production string with removable sections positioned at certain predetermined locations where it is desired to clear the area of pipe when necessary. Examples of this type of installation are found in various fields where more than one definite oil sand is known to exist. In these instances, a perforated or screened section of drillable pipe is placed on the bottom end of the oil string so that it will be located opposite the lowest oil zone. (See Fig. 1). Blank sections of drillable pipe are located in this combination string to provide removable pipe sections within known upper oil zone areas so that future production can be obtained from them. When installations of this type are made, the entire portion of the liner or oil string located above the perforated section is cemented in place to exclude fluids from any of the intermediate formations. When the lower zone becomes depleted, this section of the liner is removed with a wall scraper; a cement plug set, and the second, higher zone opened to production by removing the drillable pipe from this area. Thus, the entire sand is exposed and can be produced through a secondary screen set within the remaining portion of the original liner.

Drillable pipe is frequently used for the top sections of steel liners in certain localities as a means to provide a "window" for future deepening operations or repair work. (See Fig. 2). A sufficient length of this pipe is placed at the top end of the liner so that when removed, the directionally drilled hole will pass out of the "window" without forming a sharp bend. Drillable pipe lengths of from thirty to eighty feet below the casing shoe have been used for this purpose, dependent upon well conditions. Installations of this type allow liner tops to be cemented and thus create secondary water "shut-offs" around the casing shoe while at the same time this section of liner can be removed when it is desired to carry the well to a deeper zone or a more advantageous section of the oil pool.

A large number of drillable liners have been cemented in place from top to bottom and through one or more producing zones to effect the exclusion of intermediate water or gas sands and obtain production by means of selective gun-perforating. This method (See Fig. 3)

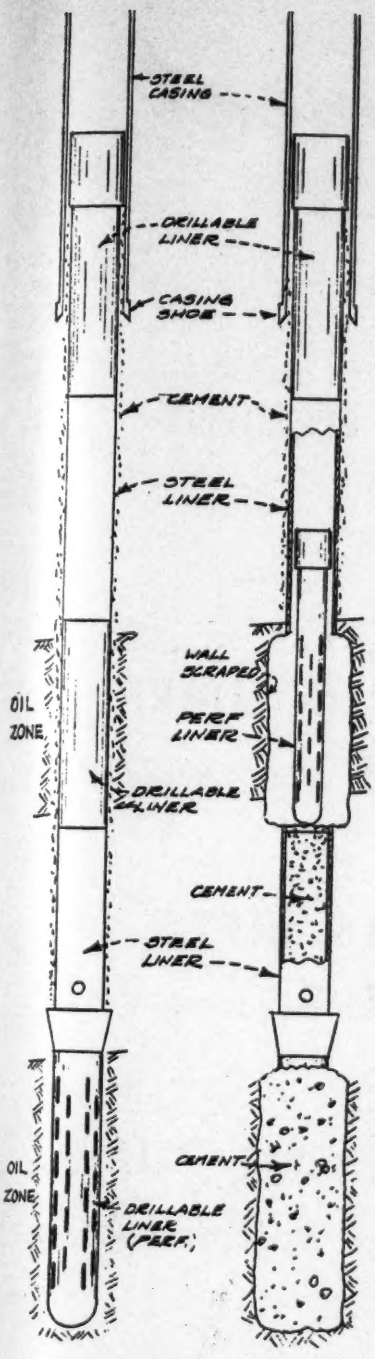


Fig. No. 1

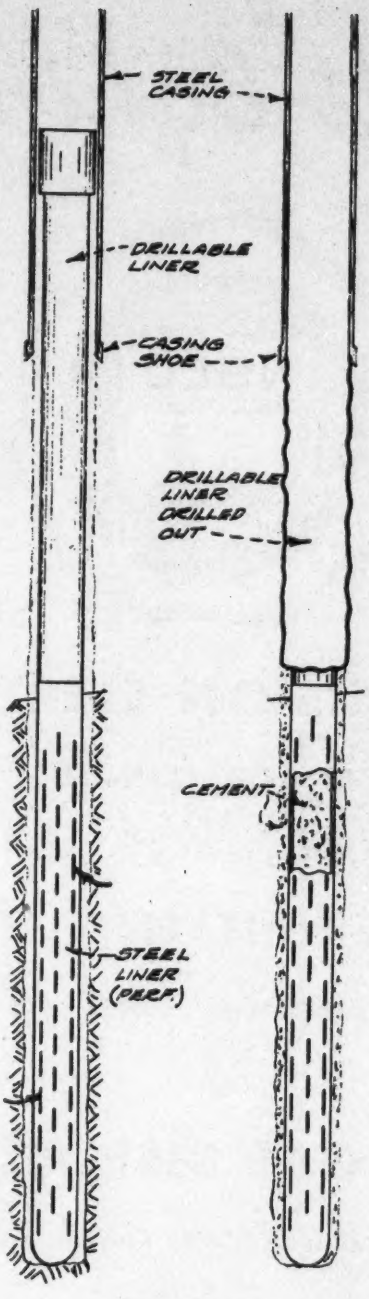


Fig. No. 2

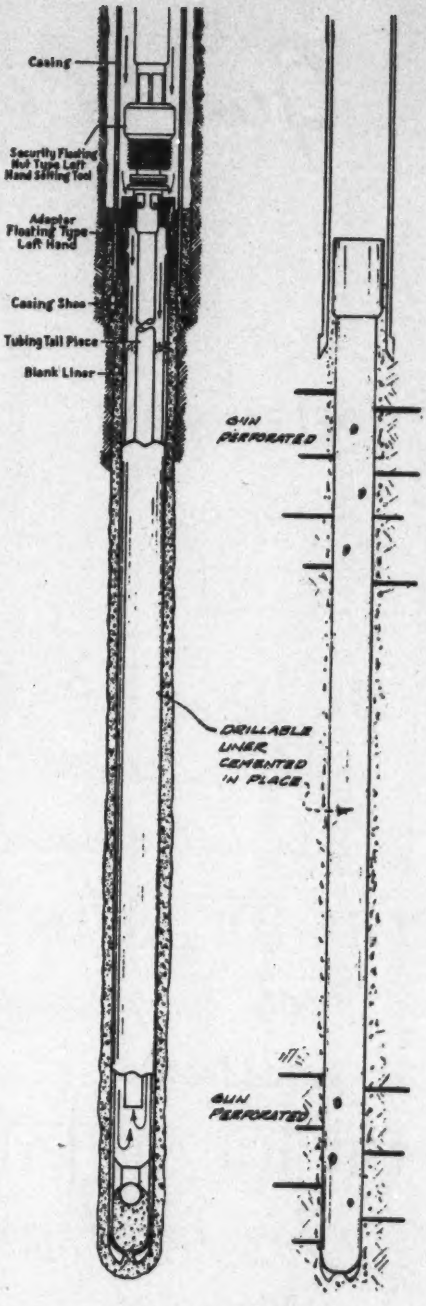


FIGURE 3

consists of running a blank liner and discharging the cement through the bottom of the liner shoe or at a point close to the bottom while a back pressure valve is used to retain the cement slurry outside the liner after the operation is completed. The liner setting tool is equipped with a sufficient length of "tail-pipe" to place the lower end within five to ten feet of the back-pressure valve. When sufficient cement has been discharged, the setting tool is disconnected from the liner and the entire "run-in" string raised a few feet. Circulation is reversed to wash away all excess cement slurry and when this operation is completed, the "run-in" string is withdrawn from the hole. The cemented liner is then perforated at selected depths to obtain the required production, and if after flow tests have been made, it is found that water sands have not been excluded or that the gas is too abundant, the entire liner can be removed with a drilling bit and sequence of operations repeated.

A similar method is used in exploratory work where several possible producing zones have been encountered. In this case (see Fig. 4) a string of blank, drillable pipe is cemented through all oil sands found between the bottom of the hole and the casing shoe. Perfora-

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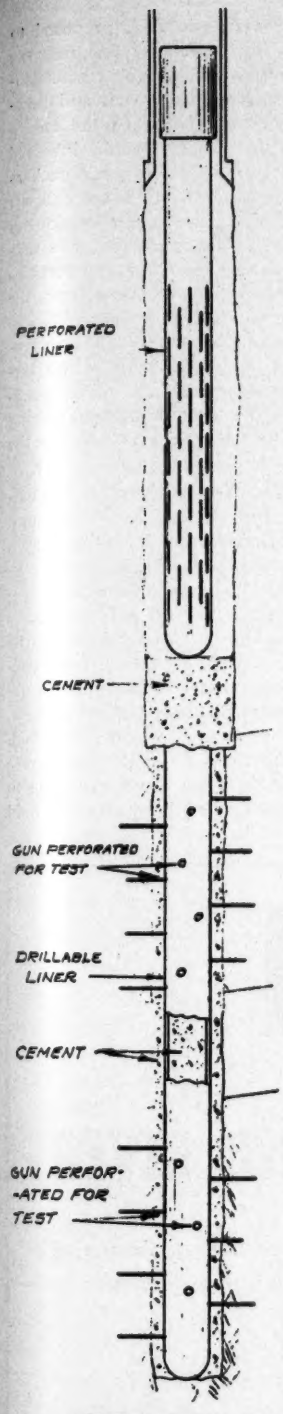


FIGURE 4

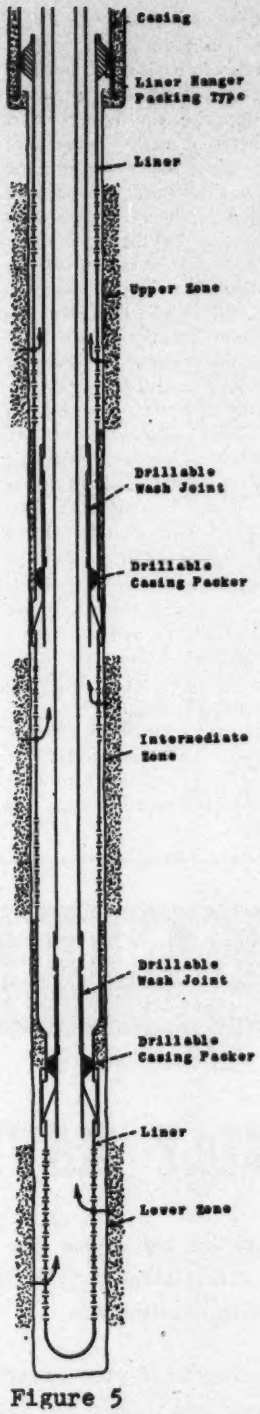


Figure 5

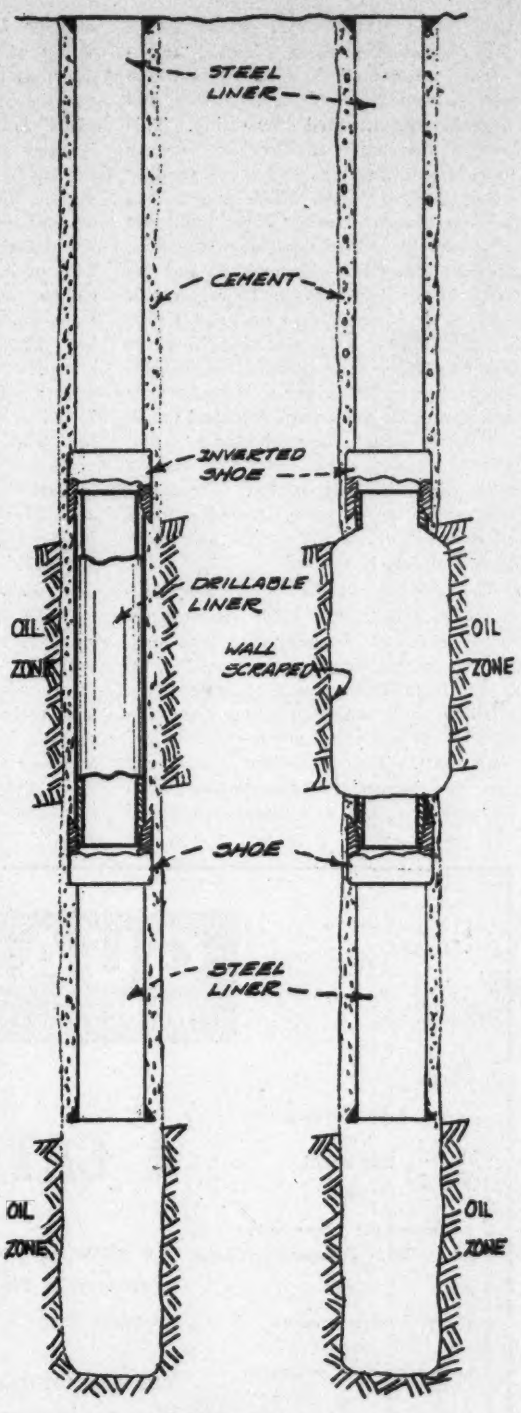


Figure 6

tions are then made in that section of pipe opposite the lowest sand and a production test performed. If this zone proves commercially unproductive, a cement plug is set and the section of liner opposite the next highest sand is perforated and tested for production. In a like manner, all zones can be tested independently of each other, and, if one proves of value, the drillable pipe is removed to the bottom of this sand and a regular liner or screen set in this area. It is not necessary to remove the entire liner as it can be drilled up at a later date if it is desired to carry the well to a greater depth.

Single well, isolated multiple zone production, whereby the fluid flow from each oil sand is diverted through a separate flow string, utilizes drillable material to overcome mechanical hazards which might exist in "hook-ups" of this type. (See Fig. 5). The production from the various zones is made to pass into a particular flow string by means of packers located directly above the lower and intermediate oil sands. Each of these packers is connected to the surface of the well by means of an independent flow string which is releasibly connected

to a "wash-joint" located directly above the respective packers. These "wash-joints" are merely by-pass ports which can be opened and closed by raising and lowering the attached flow string. This provision is made to circulate between any two flow strings and wash sand or other foreign matter which might have become lodged therein. These joints are also used to induce flow when the individual zones are first brought in and can later be used as return flow ports if certain sands are placed on gas-lift production. In the particular oil field where this multiple zone production system originated, certain of the well fluids carry an appreciable amount of fine sand which can settle around the packer and "wash-joint", freezing these parts and making their withdrawal impossible. These two units are therefore constructed entirely of drillable material so that their complete removal is assured.

Drillable pipe is also used advantageously in the Illinois fields to meet requirements for obtaining two zone production from a single well. (See Fig. 6). These installations are in comparatively shallow wells which penetrate two producing zones located about one hundred feet apart. The formations are of the type which require explosive charges to induce flow and are mainly produced without liners or screens. A single string of pipe is set from the surface down to the top of the lower zone and contains a section of drillable pipe located to be opposite the upper zone. Regular and inverted casing shoes are threaded to receive the drillable pipe section between them and are used to prevent distortion of the steel pipe after the drillable portion has been removed. Cement is then circulated to the surface so that the entire oil string is cemented from top to bottom. The drillable casing sheath, protecting the upper zone together with the cement, is removed with a wall scraper and this sand subjected to a production test. If necessary, the sand is "shot" with glycerin and given a second production test. The hole is then cleaned to bottom and the lower zone given the same treatment of testing, shooting, and final testing before the well is placed on regular production.

In these multiple production wells, it is likely that the upper zone pressure will become depleted to a point where pumping is required while the lower zone continues to have sufficient pressure to induce natural flow. In certain cases, it is necessary to provide a means whereby the upper zone can be pumped while the lower zone continues to flow in order to obtain maximum recovery from the two zones. It is proposed to accomplish this object by pumping the upper zone through the tubing with conventional pumping equipment and flowing the lower zone between the casing and the tubing. The mechanics involved consists of two drillable casing packers spaced a predetermined distance apart by means of a connecting section of drillable pipe. The upper packer is provided with intake and discharge ports to direct the formation fluid flow from the respective zones to the proper pipe elements which segregate the two zone production and carry the fluids to the surface. A secondary drillable tubing packer is run on the lower end of the tubing string to effect a fluid seal between the tubing and the upper primary packer.

The casing packer assembly, consisting of the two packers and connecting section of pipe, is run in the hole as a unit to a point which will place the packers above and below the perforated casing or open hole opposite the upper zone which is to be produced through the tubing. Both packers are set independently of each other and without the necessity of more than one trip in the hole. The upper packer is a by-pass type which separates the fluids from the two zones and allows that from the upper zone to enter the tubing and by-passes the fluid


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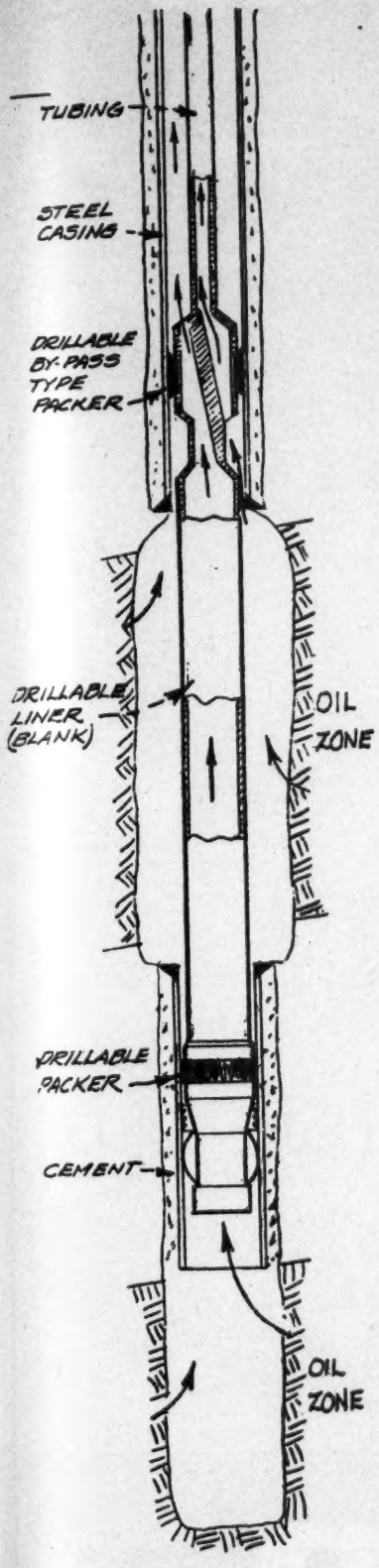


Figure 7

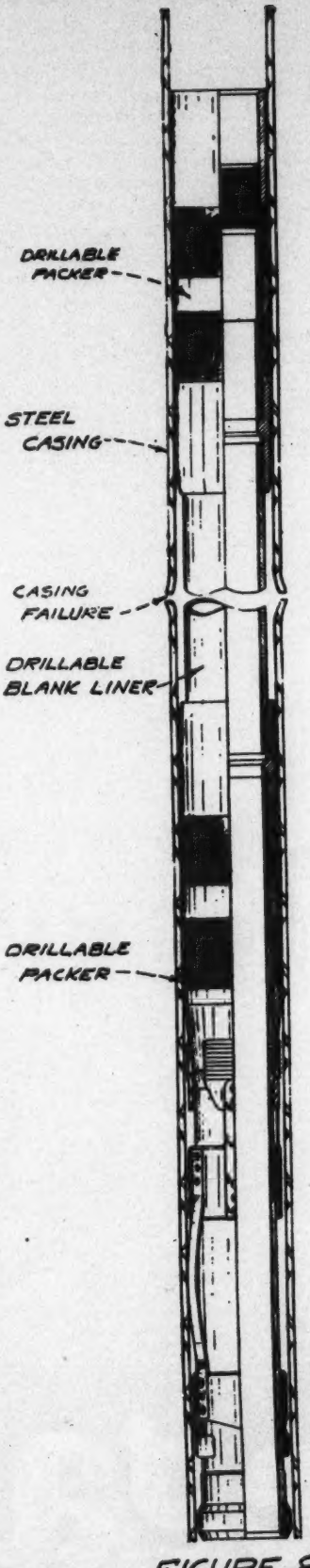


FIGURE 8

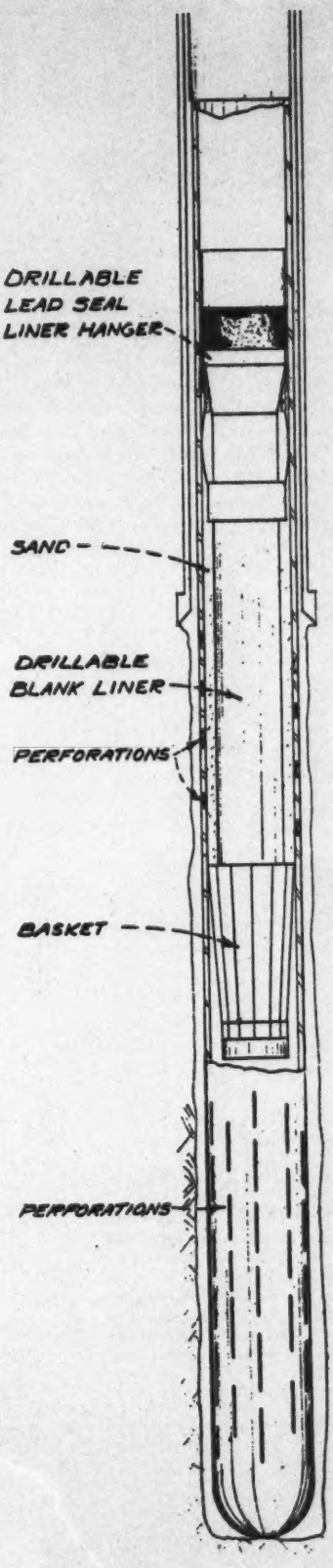


Figure 9

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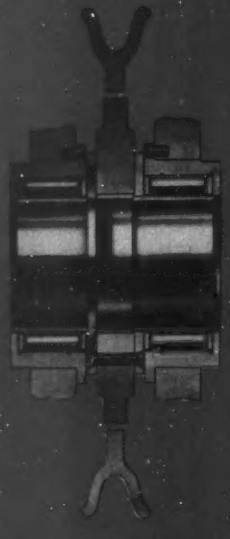

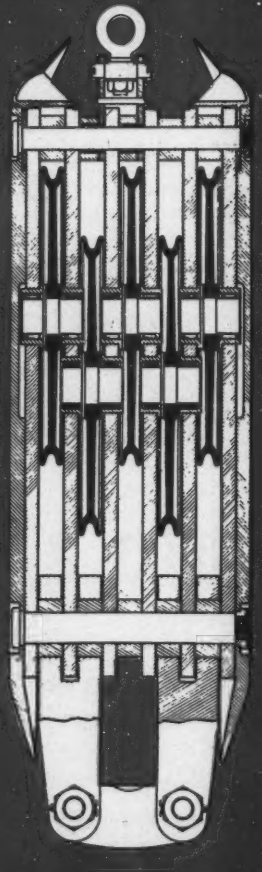

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from the lower zone so that it flows through the annular space between the tubing and the casing.

A recent development in the adaptation of drillable material to meet production repair problems has been the installation of drillable pipe sheaths or "scabs" placed inside of existing liners or casing. The purpose of these "scab" sections is to sheath cutout screen perforations or blank-off a specified section of existing liner perforations to alter the well's gas oil ratio. One method used to accomplish this type of work, consists of spacing two drillable lead seal packers a predetermined distance apart by means of a connecting section of drillable pipe of the largest diameter possible. Means are provided to set each of these packers independently of the other without the necessity of more than one trip in the hole. The complete assembly (packers and connecting pipe) is run in the well as a unit to a point which will place the packers above and below the section of casing or liner which is to be sheathed, thus leaving the drillable pipe opposite the steel section to be protected. In some cases, after the lower packer has been set, cement is forced between the "scab" pipe and the liner to form an additional packing bond. The top packer is then set and the run-in tools withdrawn from the hole. Occasionally, all or a portion of the connecting pipe is perforated to obtain production from the "scabbed" section of the liner. An example of the results obtained from this method is found in the production log of a well which had "cut-out" liner perforations and was producing from 10 to 15 per cent fine sand. While in this condition, the well was shut down for cleaning and pump repair purposes for 59 days out of a total elapsed time of 220 days, or about 39%. Since the "scab" has been placed in the well, and during a ten month period, the production flow has been constant with less than .3% sand content and no shutdown time.

Another method used to exclude unwanted gas from the production fluids consists of running a section of plain drillable liner inside of the existing steel liner to blank off the perforations opposite the gas zone. This drillable pipe is fitted with a cement basket at its lower end and a slip type packer hanger at its upper end. In operation, sand filtration through the steel liner perforations settles above the basket and gradually builds up an elongated natural bridge between the basket and the packer. The gas is then forced to move downward above the oil sand thereby imparting a greater pressure head to create increased production.

With a few exceptions, this drillable pipe is run in the hole in the same manner as steel pipe, but due to its light weight, it can be handled much easier and with smaller equipment. All threads should be inspected for cleanliness before assembling as the metal is naturally soft in comparison to steel and the threads can be damaged more easily. The joints are preferably made up with chain tongs and when tight, the tong handle should be struck several sharp blows with a sledge hammer. Although this material possesses adequate strength for its requirements, it should be handled and run more carefully than steel. It cannot withstand the same vertical column loading so it should be run in the hole at a lesser rate of speed when tight spots are known to exist, or bridges are liable to form.

It has been found that piloted drilling bits of the drag tooth type are best suited for removing drillable pipe. The diameter of the cutting blade of the pilot should be within ¼" of the inside diameter of the pipe to be removed while the diameter of the main cutting blades should conform to the proper size for the casing in the well. Adequate circulation should be provided with sufficient velocity to carry the cuttings away from the bit, and it is advantageous to circulate freely for a few minutes before each new drill pipe connection is made. A mud-shaker or screen should be used to segregate the metal chips so that they cannot be pumped back with the circulation fluid and cause the bit to plug.

Rotary table speeds of from 75 to 125 r.p.m. with one to one and one-half points of weight on the bit have shown good cutting speeds, while mud viscosities of more than 30 seem to be best suited for quick chip removal although lesser viscosities are not hindrances.

In numerous cases, drillable liners are cemented in place and naturally, the drillable material cannot be removed at a faster speed than required to drill the cement sheath surrounding the pipe. This is also true in other cases where the formation has compacted around the liner or the liner is resting against the wall of the hole. In these instances, the bit used to remove the drillable liner is forced to remove this formation as well, and similarly, the bit cannot remove the liner any faster than it can penetrate the surrounding formation.

In conclusion it can be said that drillable metals have opened a way to the application of ingenious production technique to any particular problem. The limiting factor of removability for future well work is overcome and the devices or methods used can follow most any pattern or program desired.

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# The Compression of Hydrocarbon Gases

## A Thermodynamic Analysis

Read at C. N. G. A April Meeting

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The compression of hydrocarbon gases is of importance in many of the operations involved in the production, transportation and refining of petroleum. The increasing use of "repressuring" in the field and high pressure processing in the plant has necessitated the engineering treatment of the compression of large quantities of gases to relatively high pressures. Under these circumstances some of the methods that have been employed in the estimation of compressor performance are open to uncertainties and there is possible advantage to a more fundamental treatment of this essentially thermodynamic process. It is the purpose of this paper to discuss briefly the thermodynamic relationships describing the compression of gases and to present a comparison of the behavior estimated from such relationships based upon factual information concerning the thermodynamic properties of hydrocarbon materials with the performance determined experimentally. In addition, data regarding the thermodynamic behavior of a number of mixtures of methane an ethane have been included as well as a discussion of the results obtained in an experimental investigation of compressor performance.

### General Considerations

The industrial compression of hydrocarbon gases involves the flow of the fluid to the machine, its compression and the discharge of the compressed fluid into a pipeline or receiver. Under these circumstances gas compression involves processes which must be treated from the viewpoints both of thermodynamics and of fluid mechanics. The movement of the fluid entails losses of mechanical energy which are called friction and the prediction of the magnitude of these losses must be made from a consideration of the flow conditions obtaining within the device rather than from any thermodynamic evaluation of the process. On the other hand, the minimum work required to accomplish a given change in state of a fluid may be estimated from considerations which are based entirely upon thermodynamics.

**Definition of Terms:** Before attempting to discuss the thermodynamics of gas compression it is desirable to describe a number of terms which will be used frequently in the subsequent discussion. The term "pressure" will refer to the intensity of pressure existing in a particular system or at a specified point and will be expressed in pounds per square inch absolute. The temperature will be expressed on the Fahrenheit scale and in most cases it will be necessary to employ the absolute temperature which is related to the Fahrenheit temperature, t, in the following fashion[1]:

$$T = t + 459.7 \qquad (1)$$

Throughout this discussion the quantity of gas involved will be measured in terms of its weight expressed in pounds. This can be converted to a volumetric quantity under "gas maker's standard condition" (14.73 pounds per square inch and 60° F) by the following relationship if information concerning the molecular weight and the compressibility factor is available:

$$v_m = \frac{378.0\ m\ Z^\circ}{M} \qquad (2)$$

In general, velocities will be expressed in feet per second and are related to the weight velocity, —i. e.; the weight per second passing a given point in a flowing process,—by the following equation:

$$u = \frac{10.715\ m\ ZT}{MPas} \qquad (3)$$

The velocity described in Equation 3 is essentially macroscopic or an overall average and does not represent the conditions obtaining at different points throughout the cross-section of the conduit. However, for most engineering purposes it is sufficiently descriptive of actuality to permit its use under many conditions.

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In the course of many engineering operations it is convenient to consider energy associated with a fluid as existent in a variety of forms. For present purposes it will be divided into two categories. The energy possessed by a fluid by virtue of its molecular configuration and the random motion of its individual molecules will be called "internal energy" and is designated by the symbol E. Secondly, the energy possessed by a fluid by virtue of its velocity relative to some fixed point and its elevation will be classed as "mechanical energy." It must be realized that mutual transfers between these two forms are constantly taking place in many of the processes which are involved in the compression of gases. Furthermore, it will be considered that energy may be transferred from the fluid in two ways, first as the result of the action of a force through a distance at the boundaries of the fluid which will be called "work" and secondly by virtue of the existence of a temperature difference between the system and its surroundings. This latter type of energy transfer is called "heat." In addition, the transfer of material into or out of a body of fluid is attended by the transfer of all the corresponding energy, i. e., both the internal energy and the mechanical energy which is associated with the material so transferred. The term "fluid friction" will be restricted to the losses in mechanical energy which result from motion of a body of fluid relative to its surroundings or to other parts of the system.

A "steady state" process is one occurring in a flowing system which has attained dynamic equilibrium, with the consequence that the conditions

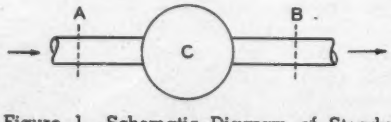


Figure 1. Schematic Diagram of Steady State Compression Process.

and the properties of the fluid at any particular point do not change with time.

**General Approach to Steady State Compression:** In Figure 1 is presented a schematic sketch of the thermodynamic essentials of a "steady state" compression process. The fluid enters the system at section **A** and is compressed by the device indicated at **C** and is delivered from the equipment at section **B**. The foregoing term "steady state" implies that the conditions at any particular point in the system remain statistically unchanged with time. It is possible to apply the law of conservation of energy to such a system and for most engineering purposes it is sufficient to consider only the two forms of energy which have been discussed. Under these circumstances the principle of conservation of energy as applied to such a system, using a unit weight of the fluid as a basis, may be expressed in the following way[2]:

$$E_A + P_A V_A + \frac{u_A^2}{2g} + h_A + Q - W = E_B + P_B V_B + \frac{u_B^2}{2g} + h_B \qquad (4)$$

It is seen that the terms on the left-hand side of Equation 4 represent the internal energy, the energy required to inject the pound of fluid into the equipment under the conditions obtaining at state **A**, the mechanical energy possessed by the fluid passing the entrance section (represented by the terms

$$\frac{u_A^2}{2g} \text{ and } h_A)$$

and the heat and work associated with the processes occurring between sections **A** and **B**. The right-hand side of the equation represents the sum of the internal and mechanical energy possessed by the system in addition to the energy required to eject the pound of fluid from the equipment. It should be realized that nothing as yet has been implied in Equation 4 as to the nature of the compression process except that none of the fluid is lost in transit from section **A** to section B. The heat Q represents energy transferred to the fluid from its surroundings. Therefore, energy transferred to the jacket water by conduction and other means constitutes a negative quantity of heat. The work term, -W, represents the energy that is transferred to the fluid during the process as the result of the action of a force through a distance. The exact point at which this energy transfer is considered as taking place is immaterial so long as it is treated in a consistent fashion. For example, if the work is measured at the crankshaft of a reciprocating compressor the heat Q associated with the process will include all the energy

[1] A table of nomenclature will be found at the end of this paper.

[2] The conversion factors to bring all the energy quantities in this and succeeding equations into consistent units have been omitted in order to leave the equations in simpler form. To convert (lb./sq. in.) (cu. ft./lb.) to (Btu./lb.) multiply by 0.1850 and to convert (ft. lb./lb.) to (Btu./lb.) divide by 778.3 or multiply by 0.001285.

transfers to the surroundings occurring as the result of temperature gradients in the bearings, stuffing boxes and other points within the machine involving mechanical friction.

From the form of Equation 4 it is seen that the work necessary for compression may be evaluated if information concerning all of the other terms is at hand. In general, the effect of changes in velocity and elevation between section **A** and section **B** may be neglected in compressor practice and under these circumstances the work may be expressed in the following way:

$$-W = H_B - H_A - Q \qquad (5)$$

In the derivation of Equation 5 use has been made of the fact that the sum of the internal energy and the pressure-volume product is defined as the enthalpy, H, of the fluid. Therefore, in such cases where the velocity and elevation of the inlet and exit fluid are not greatly different, the work of compression may be evaluated from a knowledge of the enthalpy of the fluid entering and leaving the compressor together with information concerning the heat associated with the process. It is seen that Equations 4 and 5 have been applied to a steady state compression process without regard to the details of the process involved. This method which is typical of the thermodynamic approach to many problems may be called the macroscopic or "overall" method. However, it should be realized that these relationships are merely statements of the law of conservation of energy and embody no new concepts nor do they permit the prediction of the performance in any way without recourse to factual information concerning the behavior of the fluid involved.

If the mechanical energy of the system only is considered an equation of continuity may be written for the process depicted in Figure 1:

$$P_A V_A + \frac{u_A^2}{2g} + h_A + \int_A^B PdV - W - F = P_B V_B + \frac{u_B^2}{2g} + h_B \qquad (6)$$

Equation 6 involves no new terms other than those included in Equation 4 except $\int PdV$ and the quantity F. The line integral represents the minimum mechanical energy required in compressing a unit weight of the gas from the initial to the final pressure along the path of the process. The term F corresponds to the summation of the losses in mechanical energy between section **A** and section **B** of Figure 1 as the result of relative motion of parts of the fluid with respect to the surroundings or to other parts of the system. In other words, F is the total of all the frictional effects involved. The balance of the mechanical energy for the process as indicated in Equation 6 is somewhat different in character from Equation 4 since the evaluation of $\int PdV$ and F requires information concerning the detailed nature of the process involved. The value of the integral depends upon the thermodynamic path followed by the fluid in passing from section **A** to section **B**. The frictional effects in such a process are primarily a function of the physical motions of the fluid during its passage through the compressor. The possibility of reduction of this term then rests primarily upon the reduction of "throttling processes" within the equipment.

Equation 6 may be rewritten in the following form which permits the direct evaluation of friction from information concerning the path of the process and the work since the energy differences from changes in elevation and velocity are small and can be neglected in most compression processes:

$$F = -\int_A^B VdP - W \qquad (7)$$

It is apparent from the form of Equation 7 that, since the friction is usually small compared to the work, relatively high accuracy in the estimations of both

$$\int_A^B VdP$$

and W is necessary in order to permit a reasonable estimation of the frictional effects involved.

In the case of processes such as are here considered the entropy change during the compression is related to the friction[1] and heat involved by the equation:

$$F = \int_A^B TdS - Q \qquad (8)$$

In general, in the case of the actual compression, not including intercooling, Equation 8 permits a more accurate estimation of the friction involved than does Equation 7. It should be reemphasized that a knowledge of the path of the process is essential for the solution of either Equation 7 or 8 and, in general, the information should be sufficiently representative of the conditions obtaining to describe the statistical state of the fluid at any particular point.

The foregoing description of steady state flow processes forms the basis of the evalution of the heat, work or friction associated with the compression of fluids. From the nature of these relationships it is apparent that data concerning the state of the fluid entering and leaving the compressor together with a knowledge of the heat associated with the process are necessary in order to evaluate the work of compression of fluids for which thermodynamic data are available. From a practical standpoint it is usually not difficult to determine the temperature and pressure of the fluid entering the compressor and the pressure at the outlet of the equipment can usually be estimated with adequate precision. However, the measurement of the temperature of the gas leaving the outlet valve is somewhat more difficult since the conditions are such that a number of precautions must be employed to avoid serious errors in the evaluation of this quantity experimentally. However, it is possible to predict this temperature indirectly from other information thereby avoiding this somewhat difficult and uncertain measurement. If it is desired to estimate the overall friction associated with the process, detailed information concerning the statistical average path must be available.

**Thermodynamic Path of a Steady State Compression Process:** It is possible to treat many compression processes as continuous, even for a more or less detailed consideration of the changes in state involved. In the case of reciprocating machines it must be realized that the path so obtained represents a statistical average of the conditions obtaining during the compression process and is not at all descriptive of the detailed sequence of events which takes place within the cylinder. However, such a path is of value in estimating the work and heat associated with the process and in some cases will permit the approximate evaluation of the temperature obtaining at the outlet of the compressor.

In Figure 2 is presented the path of a compression process on a temperature-entropy plane using

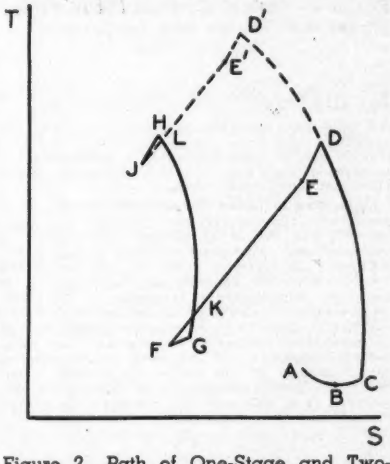


Figure 2. Path of One-Stage and Two-Stage Steady State Compression Process on a Temperature-Entropy Plane.

a unit weight of fluid as a basis. State **A** corresponds to the conditions existing at section **A** of Figure 1. During the flow to the compressor it has been assumed that there is a negligible opportunity for the transfer of energy as the result of temperature differences between the fluid and the surroundings. The reduction in pressure from **A** to **B** resulting from friction in the flowing stream has been assumed to take place at constant enthalpy. This implies among other things that the change in mechanical energy due to the change in velocity and elevation of the fluid between state **A** and state **B** is negligible in comparison to the other energy quantities. In essence, this part of the process is considered as a "throttling process" and the change in temperature indicated results from a positive Joule-Thomson coefficient for the fluid in question.

The path from **B** to **C** in Figure 2 corresponds to the entrance of the fluid into the compressor proper. The decrease in pressure again results from friction and the magnitude of this loss in mechanical energy may be related to the specific volume, velocity and to a lesser extent the viscosity of the fluid for a particular machine. Since the walls of the machine are usually at a somewhat higher temperature than that of the incoming gas, the heat associated with this part of the process is of sufficient magnitude to cause a significant increase in temperature of the gas along the polytropic curve **BC**. The process from **C** to **D** corresponds to the compression of the fluid. The exact path existing during the change of state is often difficult to ascertain since the time of compression is short and in many cases the situations obtaining digress appreciably from equilibrium. In general, the value of

$$\int_C^D TdS$$

represents the algebraic sum of the heat and friction associated with this change in state as was indicated in Equation 8. Due to the relatively low temperature of the fluid as it exists in the vicinity of state **B** it is probable that energy will be transmitted from the walls of the compression chamber to the fluid in the early stages of compression which would result in the increase in entropy indicated in Figure 2. This type of behavior is especially true in the case of reciprocating machines. However, as the process continues the temperature of the gas increases sufficiently to be above that of the surroundings resulting in negative values of heat during the latter portion of the compression process. The increasing heat transfer from the gas to the walls is reflected in the more rapid decrease in entropy with an increase in temperature at the higher pressures in the path **CD** of Figure 2. State **D** corresponds to a pressure which is somewhat above that in the receiver or outlet conduit, the magnitude of this difference in pressure depending upon the friction associated with the efflux of gas from the unit. During the flow of the fluid through the exhaust port which is usually somewhat cooler than the fluid, the path may be represented by **DE** in Figure 2. During this stage of the process energy is withdrawn from the gas in the form of heat and often at such a rate as to exceed markedly the friction associated with the decrease in pressure as is indicated in Figure 2, by the decrease in entropy from **D** to **E** resulting from this transfer of energy. In the case of a single stage compressor state **E** corresponds to the conditions existing at the outlet of the unit.

In the case of multi-stage compression involving intercoolers the path from **E** to **F** is perhaps typical of the sequence of events occurring in the latter device. The change in pressure results primarily from the inevitable frictional effects that are associated with the flow of a fluid. In general, the magnitude of this decrease in pressure may be established conveniently from a consideration of the flow conditions obtaining. From **F** the fluid passes through the second stage of the compressor along a path **FGHJ** analogous to that followed in the first stage. A third stage of compression would follow a similar sequence of events to that indicated by the path **EFGHJ** for the second stage.

Figure 2 represents the statistical conditions obtaining during the compression process and it is possible, therefore, to establish the algebraic sum of the friction and heat associated with the entire compression process by the suitable evaluation of

$$\int_A^J TdS$$

In such cases that the friction can be estimated from other considerations it is then possible to evaluate directly the heat associated with the change in state.

The dotted curve **DE'** represents the sequence of events occurring if the entire change in pressure had been accomplished within a single stage and the path **D'E'** represents the flow of the fluid out of the exhaust port under these conditions. The path **E'J** represents a substantially isobaric cooling of the gas to state **J** which corresponds to the outlet conditions of the gas after two-stage compression. The area **DD'E'LKED** minus the small areas **JHL** and **FGK** represents, therefore, the approximate saving in work requirement that might be expected from the use of two-stage as compared to single-stage compression. This difference in areas also represents the difference in the heat associated with the two processes, if the frictional effects are assumed to be comparable. Since the final state **J** is the same for both cases, it follows from Equation 4 that the increased heat represents energy which must be supplied by added work of compression. It should be reemphasized that the quantitative evaluation of the paths depicted in Figure 2 often requires more information than is available concerning industrial compressor operation.

**Conditions Existing Within the Cylinder of a Reciprocating Compressor:** In the case of reciprocating compressors it is possible to employ a more detailed approach to the evaluation of the thermodynamic path during the compression process than has heretofore been indicated. If the leakage of the valves is neglected, the weight of fluid within the cylinder is constant from that point on the cycle where the inlet valve closes to that where

[1]Strictly speaking, F includes all irreversible energy transformations occurring within the system. In gas compression, those other than fluid friction are usually small.

the outlet valve opens. Due to the relatively high turbulence existing within the cylinder and the large hydraulic radius obtaining throughout most of the stroke it would be expected that only relatively small temperature gradients would exist within the body of the fluid during the compression process. At the rates of piston travel usually encountered in natural gas compression practice it is unlikely that pressure waves would cause serious digressions from homogeneity. Under these circumstances it is possible to consider the fluid within the cylinder as a homogeneous system of constant weight. Therefore, information concerning the pressure and the total volume of the system is sufficient to define completely the thermodynamic state of the system if the weight of fluid can be established.

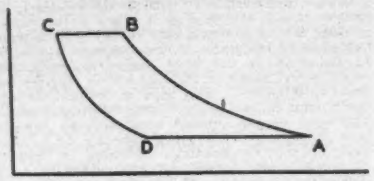

Figure 3. Pressure-Total Volume Diagram.

Figure 3 depicts information obtained from a "trimmed"[1] indicator card taken from one end of a reciprocating compressor operating upon a hydro-carbon gas. The compression process is represented by the path from **A** to **B** on the pressure-total volume plane of Figure 3. It is possible to predict the temperature of the gas within the cylinder at state **A** from information concerning the temperature of the inlet gas and an estimation of the energy transfers associated with the path **BC** of Figure 2. From the initial pressure and temperature, state **A** has been located on the temperature-entropy plane of Figure 4. The weight of the gas in the cylinder at state **A** may be established from the following equation:

$$m = \frac{V}{V} \qquad (9)$$

The specific volume, V, of the gas is a function only of the pressure and temperature which has already been established for the conditions existing at state **A**. The specific volume at any other point along the path **AB** of Figure 3 may be established through Equation 9 from the corresponding value of the total volume **V**. From the pressure-specific volume relation thus established the temperature, entropy and any other intensive properties of the fluid may be determined at points along the path if suitable thermodynamic information is available. The path of the process from **A** to **B** has been depicted on the temperature entropy plane of Figure 4.

It must be realized that in contrast to the preceding discussion of steady state processes the system now under consideration is one of constant weight and therefore, the flow equations are no longer applicable. In the present instance the work associated with the change in state from **A** to **B** may be determined by the evaluation of the following line integral which may be established directly from Figure 3:

$$W = \int_A^B PdV \qquad (10)$$

The friction and heat associated with the change are related to the temperature and the change in entropy by Equation 8 as a result of certain fortuitous equalities involved in the derivation of the relations for a steady state flow and those based only upon the first and second laws of thermodynamics.

Due to the physical configuration of the compression chamber the friction is primarily restricted to "turbulence" and therefore, is usually of a sufficiently small magnitude to permit its neglect during the change in state from **A** to **B**. Under these circumstances the heat transferred to the cylinder walls may be established from the following equality and corresponds to the sum of the areas **FAHBE** and **AGH** of Figure 4:

$$Q = \int TdS \qquad (11)$$

The gas is withdrawn from the cylinder during the changes in state occurring between **B** and **C** of Figure 3. Under these circumstances the process is somewhat more complicated since the system is one of variable weight and it is beyond the scope of the present paper to treat in detail the thermodynamics of such systems. In general, such change in state cannot be properly shown upon a temperature-entropy diagram for a unit weight system such as Figure 4, since the process is neither one of steady state flow nor one of unit weight.

After the outlet valve has closed at **C** the process again involves an essentially constant weight system during the decrease in pressure between **C** and **D**. However, in this process the weight of material involved is much less than in the compression step from **A** to **B** of Figure 3. In a fashion analogous to that employed in ascertaining the thermodynamic path existing between states **A** and **B** it is possible to portray the sequence of events obtaining between **C** and **D** on the temperature-entropy diagram of Figure 4. It should be realized that the specific entropy represented in Figure 4 corresponds to that of a unit weight—i. e., one pound of the material—and does not represent the total entropy of the weight of gas in the cylinder. This must be ascertained by the use of Equation 9 for the particular size and type of compressor in question. Again the change in state occurring between states **D** and **A** is a variable weight process and therefore, will not be considered in detail.

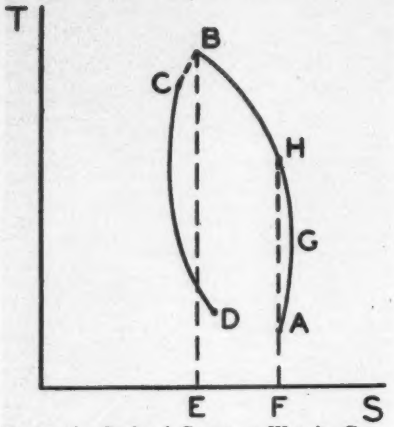

Figure 4. Path of Constant Weight Compression Process on a Temperature Entropy Plane.

It is realized that the foregoing analysis of the variable weight cyclic process is far from complete. However, it is believed that it is sufficiently descriptive of conditions to permit estimation of the maximum temperature reached.

**Estimation of Outlet Temperature:** As has been previously indicated the inlet pressure and temperature and the outlet pressure can usually be estimated with satisfactory precision without undue difficulty. However, in order to make use of the steady state flow equation in the evaluation of the work requirements a knowledge of the outlet temperature is necessary. If indicator cards are available together with information concerning the thermodynamic properties of the fluid the procedure outlined in the preceding section permits the estimation of the outlet temperature along with the thermodynamic path of the compression process. It is then possible to estimate the energy rejected as heat during the actual compression, i. e., during the change in state from **A** to **B** in Figure 3.

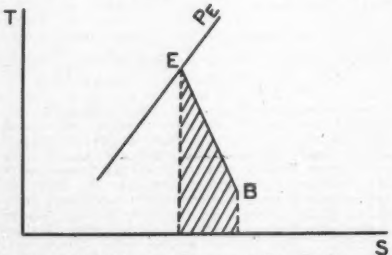

Figure 5. Linear Compression Path on Temperature-Entropy Plane.

In many instances facilities are not available for obtaining indicator cards and yet it is desirable to predict the maximum gas temperature. Under these circumstances a somewhat different approach, admittedly less accurate, must be employed. In a reciprocating compressor the friction is small during the changes in state from **C** and **D** in Figure 2 and can safely be neglected. It is necessary that information concerning the energy transferred to the walls of the compressor be available and then if the friction is known or neglected the application of Equation 8 indicates that the quantity

$$\int_A^B TdS$$

may be evaluated. As a first approximation when the friction is neglected it may be assumed that the change in entropy with temperature is uniform throughout the compression process. This would correspond to the line **BE** of Figure 5 and would represent the change in state **BCDE** of Figure 2. Since the outlet pressure $P_E$ is known, it follows that the outlet state must lie flat at the intersection **E** of the isobar $P_E$ and the line **BE** of Figure 5. In addition, the shaded area of Figure 5 must equal the energy rejected to the jacket as heat. In general, the relationship of entropy to temperature under isobaric conditions is not known implicitly and therefore, it is impossible to solve for this point of intersection analytically. However, it is known on the basis of the linear assumption that:

$$\frac{T - T_B}{S - S_B} = \frac{dT}{dS} = K \qquad (14)$$

From this relation and Equation 8 it follows that the energy rejected during the process is related to the temperature and entropy at the beginning and end of the process by means of the following relationship:

$$(T_E + T_B)(S_E - S_B) = 2Q \qquad (15)$$

Since the entropy and temperature at the end of the process are uniquely related at the outlet pressure, Equation 5 may be solved by trial for state **B** obtaining at the outlet of the compressor. It must be realized that this procedure neglects many details of the behavior of the fluid in a reciprocating compressor but it is believed that it will give at least the magnitude of the outlet temperature to be expected under a particular set of operating conditions.

The exact nature of the experimental results necessary for a thermodynamic analysis will vary with the objectives involved. The bearing friction, windage and other losses of mechanical energy exterior to the cylinder are often of interest and should be determined as a function of operation conditions. The energy rejected to the jacket should be determined as a function of the mean temperature difference between the fluid and the walls of the compressor for a variety of compression ratios and rates of throughput. In the course of this work the temperature of the gas may be established from indicator cards and the thermodynamic properties of the fluid involved, using methods that have been described. Figure 6 shows the amount of energy rejected in the form of heat as a function of the mean temperature difference between the jacket water and the gas. These results were obtained by Scheel for an 11½" by 20" Cooper compressor operating upon natural gas with 8.4 per cent clearance and at a speed of 200 r.p.m. It is seen that a reasonable relation is obtained in this case. The outlet temperature was measured by a thermocouple in the exhaust port and is probably reasonably representative of the conditions existing there.

It is often desirable to estimate the friction losses resulting from the flow of the fluid through the compressor. In Figure 8A is presented an indicator card obtained during the aforementioned test of a Cooper compressor. The small areas at bottom and top represent the work necessary to permit entrance of the gas to the cylinder and to discharge it during the latter part of the cycle. In this instance this friction is represented by the $\int PdV$ in contrast to the $\int VdP$ indicated by Equation 7. This results from the fact that Equation 7 is applicable to a steady state flow process while the friction indicated by the shaded areas in Figure 7 applies to a homogeneous system of variable weight and is therefore equal to the work necessary above that required for a "reversible" delivery of the gas from the cylinder. In general, it is possible to correlate this friction for a particular machine with the geometric form of the valve and the cylinder area together with the piston speed and suction line velocity as was indicated by Scheel[2].

Once having information of this nature concerning the performance of a particular compressor when operating on a single fluid it is readily possible to predict the behavior of the machine when operating upon other gases for which suitable thermodynamic data are available. The work required to accomplish the desired compression of a gas

(Continued on Page 38)

[1] A "trimmed" indicator card is one which has been corrected for the friction associated with the flow of the fluid into and out of the cylinder.

[2] Scheel, Report of C.N.G.A. Committee on Gas Engines and Compressors, October 21, 1936.

# Field Development

## San Joaquin Valley

### Amerada Discovers Major Oil Field

Biggest news in the California Oil Industry for the year 1939 is the flash from Coalinga that Amerada Petroleum Corp. completed its East Coalinga wildcat flowing an estimated 2000 bbls. of high gravity oil and 10,000,000 cu. ft. of gas.

The well apparently opens an entirely new field on the Eocene shoreline east of the old Coalinga production.

With the hole finished at 8237 ft. in sand similar to the Gatchell, and with 7 in. casing cemented at 8022 ft., a 5 in. drillable liner containing 139 ft. of perforation was landed on bottom and cemented at 8097 ft. This procedure was followed to exclude the high pressure gas found in the top of the sand at 8037 ft. The top of the dark oil sand is placed at 8078 ft.

At first thought of as an extension of the proved Eocene production four miles to the south, the new field is now believed to be a separate accumulation in the stratigraphic trap formed by the Kreyenhagen shales overlying Eocene shoreline sands. Ultimate size of the productive area must remain pure conjecture until proved by the drill. The discovery well is located approximately 990 ft. north of sec. 17,19-16, four miles north of established Coalinga Eocene production and two miles east of the old Coalinga East Side field.

### 7 Strings Running in Coalinga Eocene Pool

The Eocene area in the structure straddling the Range line 15-16 east at Township 20 north, is one of the most closely watched fields in the valley. Producing with steady flow from the rich Gatchell sand, the area is establishing valuable reserve acreage unlikely to be depleted by competitive drilling. Since the pool is covered by large leases under the control of a few reputable and conservative operators, production by flowing should continue for many years. Gas wastage has been eliminated and prorations are strictly observed.

Superior Oil Co. Cagle No. 2 in sec. 6, and Coalinga Fee No. 6 in sec. 7 are drilling ahead, nearing the Gatchell pay zone.

Robert S. Lytle, Operator, Well No. 31-7F is drilling below 6700 ft. after finding the top of the grit zone at 6740 ft. The green sand marker was found at 6707-6720 ft. Well No. 62-7F topped the Kreyenhagen at 6352 ft. and is now below 6940 ft. Well No. 3-18F is coring below 6500 ft. after reporting the top of the Kreyenhagen at 5700 ft.

Mr. Lytle has made locations for wells No. 86-12C, 51-7F, 75-7F and 5-18F.

Standard Oil Co. No. 73-13C is drilling below 6500 ft. in sec. 13,20-15. Location for No. 84-13C is given as near the east quarter corner of the same section.

The Texas Co. Exeter No. 1 in sec. 6, is drilling at 7000 ft. with No. 2 of the same section reported as a grade only.

Holly Development Co. Well No. 82-12C in sec. 12 has rig up near the westerly line of proved Eocene production.

### Arvin Area Gets Second Producer

Superior Oil Co. has completed P. D. Jewett No. 1 for 784 bbls. gross daily open flow. The output is 30 gravity plus, cutting 20%. The well is one location south of Standard Oil Co. Jewett No. 1, discovery well in sec. 16,31-29, which initialed at 2988 bbls. daily through a 50/64 in. bean, and is at present shut-in.

Standard Oil Co. has made location for Jewett No. 2, an offset to drilling wells in the same section.

Northwest of present production in the very active sec. 16, The Texas Co. Jewett No. 1 is drilling near 4000 ft.

East of production and near the west line of sec. 15, Universal-Consolidated Oil Co. is drilling below 3500 ft. in Universal-Derby No. 1.

The area lies immediately south of the Mountain View field and north of previously discovered small production. Drilling history and geologic characteristics indicate that the play will extend westerly from the apparent fault lying east of discovery.

### Round Mountain To Get New Driller

Crestmont Oil Co. has erected rig for Staley No. 6 in sec. 8,28-29. The project will be the most northwesterly test of the small area operated by Crestmont, Eastmont Oil Co. and Tampico Petoleum Co. whose leases have a common corner at the junction of sections No. 8-9-16-17 of township 28-29.

Grizzly Bear Petroleum Co. Kelly No. 2 in section 6 is preparing to test for production after cementing casing at 1678 ft. The top of the Vedder oil sand was found at 1661 ft. Bottom of the hole is at 1705 ft.

### Gen. Pet. Spuds Buena Vista Well

With 500 ft. of 13" surface pipe in place, General Petroleum Corp. is below 2500 ft. in the Buena Vista Lake Area test in sec. 1,32-24. The well, known as BVA No. 1, is located on large company holdings at the edge of the old lake bed. The area, while much drilled, has been tested only for comparatively shallow depths and may produce from heretofore untested zones. The drill has tested only to the Monterey Shales of the Miocene Age, leaving five older horizons

for prospecting, all of which have produced oil in the Valley. In the event of production, the deep zone would probably be an extension of the old Buena Vista Hills field.

Ten miles to the northeast, Western Gulf Oil Co. has completed pouring foundation for KCL-Panhandle No. 1. Located in sec. 3,32-26, a mile and a half from the southerly tip of the Buena Vista Lake gas field, the well will be drilled in nearby virgin territory. The sole drilling operation in the area to date being a test by the Ohio Oil Co. in sec. 4,32-26, which was carried to 5627 ft. under the well name of KCL B-1.


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## Two Wells Drill In Fruitvale Field

White & Smith's Galtes No. 1, in sec. 14,29-27, was spudded on the 16th and was last reported as drilling below 1700 ft. The well was originally reported as an H. G. Smith project.

Western Gulf Oil Co.'s southerly outpost try in sec. 34,29-27, is reported as having passed through the base of the Etchegoin at 3508 ft. The project is now drilling below 3637 ft. and headed for the lower zones where oil is normally found in this field.

Western Gulf, largest Fruitvale operator, has done much outpost development in an effort to extend the limits of the comparatively small structure.

## Coalinga West Side Well Is Completed

Foreign Oil Co. completed Pacific States Annex No. 6, near the south tip of West Coalinga production, in sec. 6,21-25, pumping 25 bbls. of 30 gravity oil cutting 25% water.

Leo Jarvis Well No. 2, located in sec. 14,20-14 at the west edge of the field, was abandoned at 805 ft. The Domengine Reef Bed was found at 803 ft.

Westerly outpost well, Roco Oil Co. Lindblom No. 1, in sec. 3,20-14, is drilling below 1000 ft. in fine gray sand of Cretaceous age.

Stuart Oil Co. is preparing to run liner in Stuart No. 1, sec. 12,21-14. The Tyler & Cornwell well is testing water shut off on 8⅝" pipe set at 245 ft. with bottom reported at 310 ft.

## Poso Creek To Get Production Try

Little & Gilstrap, operators of Keating No. 1, small producer in sec. 20,27-27, are preparing to drill a second well in the same section in an effort to extend the known productive area. The test, to be known as Keating No. 2, lies in the Poso Creek area a mile and a half north of the edge of the Premier field.

Keating No. 1 was completed late in 1938 pumping 25 bbls. of 13 gravity oil cutting 50% from 2046 ft. in the Contact zone.

## Elrich Comm. No. 1 Barren in Eocene

Standard Oil Co. Elrich Comm. No. 1, located south of the fault in sec. 20,29-26 in the Greeley field, has so far penetrated nearly all of the geological section of the San Joaquin Valley floor without finding production. Gray sands reported as Eocene were topped at 13,447 and 14,477. Total depth of the hole is given as 13,525 ft. which even by new drilling standards is deep.

Better luck on other projects in the field is reported by Standard. KCL No. 11-17 found the top of the Vedder at 11,336 ft. and is now standing with the bottom of the hole at 11,373 ft. and 6 in. pipe cemented at 11,320 ft.

KCL No. 11-16 found the top of the sand at 11,424 ft. and is bottomed at 11,427 ft. Casing is set at 11,415 ft. and the water shut off is being tested preparatory to drilling into the sand.

Standard has two other strings running in the field. KCL No. 11-18, spudded on the 15th is drilling below 4500 ft. while KCL No. 12-6 is entering the deep class by drilling below 10,500 ft.

## G. P. Completes Rio Bravo Well

General Petroleum Corp. completed Caldwell No. 1 at Rio Bravo flowing at a 1700 bbl. rate. Located in sec. 35,28-25, production was 36 gravity oil cutting 8.0% with more than a million feet of gas.

General Petroleum's Van Ness No. 2 is drilling in sec. 2,29-25 below 8000 ft. in hard shale. Superior Oil Co. Moodie No. 1 is again making good time below 9700 ft. after recovering bit cutters from the hole. Heaviest equipment ever used in California is employed on this well.

Union Oil Co. Kernco No. 8-34 is drilling as an offset to present production in sec. 34,28-25 and is in brown shale and sand below 8600 ft.

## Buttonwillow Project Drills Below 12,800 Ft.

California Exploration Co. Dougherty-Salisbury No. 1 in sec. 7,29-24 near Buttonwillow is now in the very deep hole class. Having encountered streaks of hard, tight oil sand and shale for more than a thousand feet, the well has excited much interest in the area. With the drill in hard sandy shale below 12,814 ft. and going ahead, the company hopes that a softer, better saturated sand will soon be found. While the sand so far encountered has shown good cuts at times, and the little oil recovered on a formation test at 11,560 ft. was of 35 gravity, the formation is very tightly packed and of low permeability; sands that provide practically no reservoir for petroleum accumulation.

The test is located on the Canal-Buttonwillow axis, in an area which has had numerous shallow tests, none of which at any time was promising.

## SAN JOAQUIN VALLEY WILDCATS

### Fresno County

| Area | Well | No. | Section | Depth | Status |
|---|---|---|---|---|---|
| Cantua Creek | Shell Oil Co., Port Costa | 48–30 | 30, 17-16 | 5573 | Drilling |
| Coalinga | Amerada Pet. Corp., SPL | 7–17 | 17, 19-16 | 8237 | Drilling |
| | American Oil Fields, Inc. | 1 | 16, 19-15 | 180 | Idle |
| | Foreign Oil Co. | 6 | 6, 21-15 | 2540 | Producing |
| | Jarvis, Leo P. | 2 | 14, 20-14 | 805 | Abandoning |
| | Progressive | 3 | 20, 19-15 | 852 | Idle |
| | Roco Oil Co., Lindblom | 1 | 3, 20-14 | 950 | Drilling |
| | Rylatt, Harry E., Kipling | 3 | 26, 20-14 | 1300 | Idle |
| | Stuart Oil Co., Stuart | 1 | 12, 21-14 | 1410 | Drilling |
| Fresno Area | Seth Turner | 1 | 4, 14-19 | | Rig |
| Gatos Creek | Gatos Creek Oil Co. | 1 | 19, 19-13 | | Rig |
| Jacalitos Hills | Dauphin Dev., Ragan | 1 | 30, 21-14 | 4587 | Idle |

### Kern County

| | | | | | |
|---|---|---|---|---|---|
| Arvin | Superior-Standard-Texas, Jewett | 1 | 16, 31-29 | 6270 | Producing—Shut in |
| | Jewett | 2 | 16, 31-29 | | Grade |
| | Superior Oil Co., P.D. Jewett | 1 | 16, 31-29 | 6400 | Producing |
| | The Texas Co., Jewett | 1 | 16, 31-29 | 3955 | Drilling |
| | Univ. Consol. O. Co., Univ-Derby | 1 | 15, 31-29 | 3654 | Drilling |
| Belridge | Honolulu Oil Corp., Michelssen | 63 | 14, 28-20 | 1687 | Producing |
| Buena Vista | Gen. Pet. Corp., B.V.A. | 1 | 1, 32-24 | 2916 | Drilling |
| | Western Gulf Oil Co., K.C.L. Panhandle | 1 | 3, 32-26 | | Rig |
| Buttonwillow | Calif. Explor. Co., Salisbury | 1 | 7, 29-24 | 12828 | Drilling |
| Canal | Shell Oil Co., KCL | B-87 | 4, 30-25 | 13617 | Drilling |
| Coles Levee | Ohio Oil Co. | KCL-F2 | 10, 31-25 | 9917 | Drilling |
| | Ohio Oil Co. | KCL-F3 | 11, 31-25 | | Rig |
| | Richfield Oil Corp. | 2nd B-14-3 | 3, 31-25 | 4585 | Drilling |
| | Standard Oil Co. | KCL 20-1 | 9, 31-25 | 8684 | Drilling |
| | Tide Water Associated | KCL-61 | 14, 31-25 | 7811 | Drilling |
| | Union Oil Co., Kernco | 1–11 | 11, 31-25 | 9715 | Producing |
| Delano | Atlas Pet Co., Moore | 1 | 7, 25-25 | 3376 | Drilling |
| Devil's Den | Luxton, W. L. | 1 | 27, 25-18 | 710 | Idle |
| Edison | Hillview Oil Co., El Tejon | 1-A | 11, 30-30 | 2661 | Idle |
| | Renner & R.H.L. Oil Co. | 1 | 27, 30-30 | 2600 | Idle |
| Elk Hills | Richfield Oil Corp. | A-52-32 | 32, 30-25 | 8793 | Producing |
| | Richfield Oil Corp. | A-12-33 | 33, 30-25 | | Rig |
| | Standard Oil Co. | KCL 21-1 | 19, 30-25 | 4396 | Drilling |
| Grapevine | Petrol Corp., Reserve | 33–5 | 33, 11-19 | 8946 | Idle |
| | Richfield Oil Corp. | KCL 1 | 28, 11-20 | 9975 | Drilling |
| Lost Hills | Auman, Allen | Lincoln-Theta 1 | 12, 26-20 | 560 | Drilling |
| | California Lands, Occidental | 2 | 24, 26-20 | 5623 | Prep. to resume |
| Mt. Poso | O. F. W. Oil Co., Villard | 1 | 28, 26-28 | | Rig |
| | Shell Oil Co., Glide | 1 | 29, 27-28 | 2508 | Abandoned |
| | Wright & Eyer | 1 | 28, 26-28 | 878 | Drilling |
| Poso Creek | Little & Gilstrap, Keating | 2 | 20, 27-27 | 1893 | Drilling |
| Midway | Fried, Julius | 1 | 34, 32-24 | 5035 | Idle |
| Richgrove | Dilamar Oil Corp., Quinn | 3 | 15, 25-27 | 2929 | Idle |
| Round Mountain | Round Mountain Co. | 1 | 24, 28-29 | | Rig |
| | Spartan Oil Co. | 1 | 32, 28-29 | | Rig |
| San Emigdio | Continental Oil Co. | KCL F-1 | 5, 10-21 | | Rigging up |
| | Shell Oil Co. | KCL 1A-8-32 | 32, 11-22 | 4388 | Drilling |
| Shale Hills | Abbots, Frank | 7–1 | 7, 27-19 | | Rig |
| Strand | Continental Oil Co. | KCL D-2 | 14, 30-26 | 4447 | Drilling |
| | Tide Water Associated Cont. | KCL-E-35-7 | 7, 30-26 | 6336 | Drilling |
| Trico | Standard Oil Co., M.&L. | 8–1 | 3, 25-23 | 2463 | Shut in |
| | Standard Oil Co., T. G. & T. | 2 | 2, 25-23 | | Location |
| | Trico Oil & Gas | T&G 1 | 2, 25-23 | 2440 | Prod. |
| Upper Kern River | C.C.M.O., Julienne | 1 | 2, 29-29 | 2030 | Drilling |
| | Kern Valley Drlg. Co. | 1 | 4, 29-29 | | Rig |
| Wasco | Getty, George F., Janssen | 1 | 7, 27-24 | | Foundation |
| | Union Kernco | 1–36 | 36, 27-24 | 12630 | Drilling |

### Kings County

| | | | | | |
|---|---|---|---|---|---|
| Strattford | P. W. Burnham & Assoc. Bartells | 1 | 23, 20-20 | | Rig |


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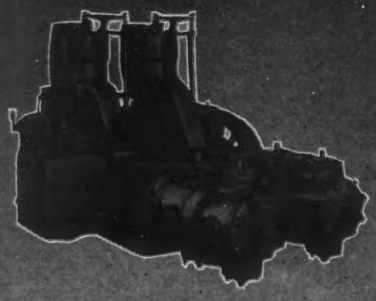

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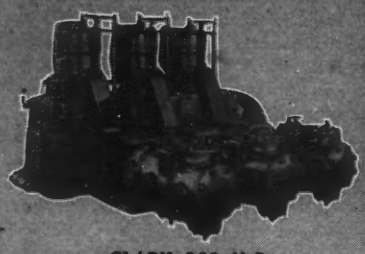

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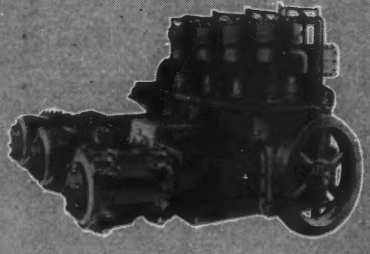

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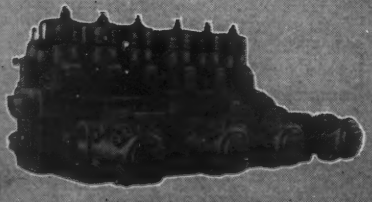

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## Shafter Test Finds Vedder Sand Gray

The fourth 13,000 ft. hole to prospect for deep production near Wasco, has apparently collapsed as a possible producer. Union Oil Co., Kernco No. 1-36, sec. 36,27-24, found the Vedder sand barren. Last reported at 12,630 ft., the project was still drilling ahead with prospects of early abandonment. Top of the zone found at 12,543 ft., was gray but showed the appearance and smell of gas bearing sands.

The test was a joint project of Union, Tide Water Assoc., Seaboard, and Continental Oil Co. and like the other deep drilling operations in the district, it found only hole and lots of it.

Five miles to the northwest in the proved Wasco area, Standard Oil Co. completed Mushrush No. 2 flowing at a 6144 bbl. rate through a 36/64 in. bean. Gravity was 36.2 and cut .06%. Pressures were 1105 lbs. on the tubing and 1115 lbs. on the casing with 578,000 cubic feet of gas. Production was from 62 ft. of perforated 5 in. landed at 13,122 ft., three feet off bottom.

South of the proved area in sec. 17, Standard KCL No. 8B-2 is drilling in hard shale below 13,000 ft.

## Two New Drillers At McKittrick

Reentering the drilling field after a lengthy absence, Manley & McGinn operators of 25 valley wells, are spudding Well No. 15 in sec. 15,31-22. The company was organized in San Francisco in 1933.

Taking an active part in the development of the McKittrick proved area, E. D. Robertson has spudded Robertson No. 1 in sec. 13,30-21. Progress reports last placed the well below 680 ft. and drilling ahead.

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## Canal Wildcat Hits Barren Vedder

Shell Oil Co., in the deepest hole drilled by the company in California, KCL B-87-4, found the barren Vedder formations at 13,375 ft. Bottom of the hole is at 13,617 ft. in hard gray shale showing slight cuts in the gray sand above it.

The well is located 2 miles northwest of the Canal field in sec. 4,30-25.

In the Canal field proper, Shell Oil Co. has completed No. A-23-14 flowing at an 1886 bbl. rate. The production, obtained from 8169-8334 ft., was 35 gravity clean oil with more than a million and a quarter cubic feet of gas.

Shell is drilling ahead with No. A-36-14 in the same section. Now below 5100 ft. in sand and shale, the project was spudded on April 14th.

Another driller on section 14, Ohio Oil Co. KCL. No. E-11, stands cemented at 8300 ft. after topping oil sand at 8175 ft. An offset to established production in a field with a trouble free drilling history, the well is assured of good production.

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## Shell Abandons Mt. Poso Try

After drilling an aggregate of 4016 ft. from one rig location, the Shell Oil Co. abandoned Glide No. 1 in sec. 29,27-28 The test, located a mile and a quarter west of the field limits, was originally drilled to 2504 ft. After finding the top of the Vedder at 2298 ft., and oil showings at 2335 ft. where the sands ran out, the hole was plugged back to 996 ft.

The second try, directionally drilled from the top of the original hole, was carried from the plug to the top of the Vedder at 2275 ft. Slight oil showings were sufficient encouragement to warrant further drilling and the test was carried to a bottom of 2508 ft. without encountering productive sands.


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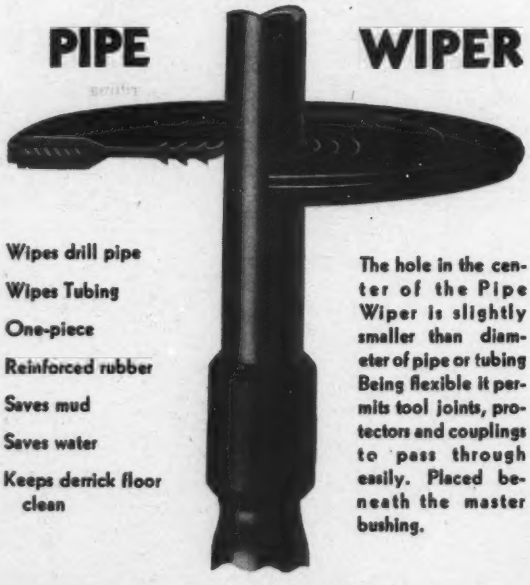

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# Los Angeles Basin

## West Montebello Outlook Is Better

Much of the heavy cloud of doubt hovering over the West Montebello field was dispelled during the past two weeks. Easterly wells which formerly looked questionable have proved to be "in the money" and the field is yet without a dry hole.

Union Oil Co. brought in its east end outpost, La Merced No. 30, flowing 710 bbls. of 35 gravity oil cutting 12.5% from the interval 7550-7630 ft. This is an entirely new productive horizon.

At the intersection of 6th St. and Lincoln Ave., Graham & Loftus Oil Co. is preparing to complete Coffman No. 1 in the lower Seventh zone. Casing has been cemented at 7397 ft. and it is planned to land a liner on bottom at 7557 ft.

Across Lincoln Ave. to the north, Wood-Callahan Oil Co. is preparing to complete Harris No. 1 in the same zone, with casing at 7405 ft. and bottom at 7525 ft. Formation tests in both this well and the Graham & Loftus project indicated that good production will be obtained.

South of Union's Calkins No. 1 and east of Montebello Blvd., Vulcan Oil Co. completed its Nash No. 1 flowing 550 bbls. a day from the Masser (fourth finger of the Sixth zone). A 57 ft. interval is open to bottom at 6689 ft.

A novel test is being made of the second finger of the Sixth zone in Traders Oil Co. No. 1, located in the center of Avenida de la Merced at Montebello Blvd. With casing at 6352 ft. and bottom at 6438 ft., an open hole test is being made with a formation tester run on tubing.

At the west end of the field, Bush Oil Co.'s outpost, Olds No. 1, is coring for the Masser zone. If this well is successful in either the lower Sixth or the Seventh zone, it is probable a new west end drilling campaign will follow.

North of Lincoln Ave. and west of Maple, Kern-St. Helens Properties completed Monterey No. 30 in the Seventh zone for 700 bbls. and is attempting a multi-zone completion in the Masser. The company's Monterey No. 20 and Eggleston No. 2 are testing intervals of the Sixth zone.

Standard Oil Co., after recently completing Kaufman Fee No. 2 for 600 bbls. in the Hathaway (Seventh) zone, now has four strings of tools running. Braun No. 3, on the old Benedictine lease, is probably the nearest to production, having been deepened from the Masser zone to the Hathaway.

The Texas Co. is testing the Masser zone in Mulholland No. 5 before final completion while Union Oil Co. is preparing to set casing over the lower zone in Wilcox No. 2.

V-8 Oil Co. is deepening its M. B. No. 1 to the Hathaway in the Victoria and Maple section. A block and a half to the north, Montebello Reservoir Oil Co.'s No. 2 is drilling below 5500 ft. Stanley Oil Co. is sidetracking the fish lost on bottom at 7000 ft. Herley-Kelley Oil Operations Masser No. 2 is drilling at 3500 ft. Beverly Montebello Oil Co., an O. J. Rohde company, will soon spud Corbett No. 1 offsetting Vulcan Oil Co.'s producer.

## Wilmington Again State's Busiest Field

With Torrance definitely passé, and with the recent issuing of many permits for new wells in the harbor district, Wilmington is again far in the lead in development work in the State. Largest number of new projects for a single company was eight taken out by Long Beach Oil Development Co. to drill the Long Beach municipal tidelands. Actual drilling will be done by sub-contractors Thomas P. Pike Drilling Co.; D. W. Elliot; Dunlap, Fadler & Haines and Brown Drilling Co. Two new wells will be drilled on the City's lease to the Termo Co. adjoining the Edison plant, one of which will be bottomed beneath the entrance channel.

Permits for five wells to be whipstocked under the turning basin were obtained by Signal Oil Co. The rigs will be located on property owned by the Southern Pacific Railroad and leased to General Petroleum Corp.

Most interesting of the remaining new proposals is that of Seacoast Oil Co. to drill a semi-wildcat in the Terminal Island area of the Wilmington district. The project will attempt to extend production to the south and west, and due to its proximity to the Navy air field will probably have to employ a short derrick.

Two new wells are scheduled for

**LOS ANGELES BASIN WILDCATS**

| Area | Well | No. | Section | Depth | Status |
|---|---|---|---|---|---|
| Bellflower | Clayton, Geo. L., Scott | 1 | 32, 3-12 | 6897 | Idle |
| Castaic | Royal Land Corp. | 1 | 8, 4-17 | 1338 | Idle |
| La Mirada | John KcKeon and Assoc. Carmenita | 1 | 21, 3-11 | 8990 | Idle |
| Long Beach | Richfield Oil Corp., Richville | 1 | 13, 4-12 | 6320 | Drilling |
| Mojave | Mojave Pet. Co., Gorman | 1 | 5, 8-18 | 510 | Idle |
| | Jennings | 2 | 33, 5-14 | 520 | Idle |
| Montebello-West | Ridge Oil Co., Sea Cliff | 1 | 3, 2-12 | 5290 | Drilling |
| Newhall | Mangrum and Page, Lintz | 1 | 4, 3-15 | 390 | Idle |
| | Newhall Drlg. Asso., Needham | 4 | 13, 3-16 | 3505 | Idle |
| | Palmluck Oil Co. | 1 | 23, 3-16 | | Rig |
| Palmdale | Neu-Cal | 1 | 17, 6-12 | 1250 | Idle |
| Palos Verdes | Rolling Hills Pet. | 1 | 27, 4-14 | 5385 | Idle |
| Playa del Rey | Empire Oil Co., Samarkand | 1 | 34, 2-15 | 775 | Idle |
| San Pedro | Grady, R. T. | 1 | 23, 5-14 | 650 | Idle |
| Sunland | South Alta Oil Co. | 1 | 1, 2-15 | | Rig |
| Torrance | Blackstone Oil Co. | 1 | 2, 4-14 | | Grade |
| Whittier | Gregfield Oil Co., Gregg | 1 | | | Rig |
| | Langstaff, Geo. W., Iliff | 1 | 8, 2-11 | 2250 | Idle |
| | H. C. Oil Co., Joyce | 1 | 22, 2-11 | 3600 | Idle |
| | C. W. Partridge, Hillside | 1 | 22, 2-11 | 1780 | Cleaning out |
| | **Orange County** | | | | |
| Anaheim | The Texas Co. | A-13-1 | 8, 4-10 | 8977 | Abandoned |
| Bolsa Chica | Patos Drilling Co., Graham | 1 | 21, 5-11 | 6673 | Abandoned |
| Costa Mesa | A. V. Oil & Gas Co. | 1 | 16, 6-10 | 4751 | Idle |
| Kraemer | Congress Oil Co. | 2 | 36, 3-9 | | Foundation |
| Seal Beach | Union Oil Co., Nieto | 1 | 12, 5-12 | 5663 | Drilling |
| Yorba Linda | Shell Oil Co., Stern | 1-A | 23, 3-9 | 1661 | Abandoned |
| | **San Bernardino** | | | | |
| Carbon Canyon | Carbon Canyon Oil Co. | 1 | 30, 2-8 | | Rig |
| Chino | So. Counties Pet. & Drlg. Co. | 1 | 22, 2-8 | 2830 | Idle |
| | **San Diego County** | | | | |
| Carlsbad | Dauphin Dev. Co., Kelly | 1 | 16, 12-4 | 1201 | Idle |
| | **Imperial County** | | | | |
| Salton Sea | Cawthon, Max (Carbon dioxide well) | Section 2 | 2, 11-13 | | Location |

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drilling in the northwest sector of Wilmington. Brookline Oil Co. and Stanley Oil Co. will each drill near the corner of "I" St. and Avalon Blvd. In the older Wilmington townlot sector, Zephyr Oil Co. will drill at the intersection of Sanford and "D" Sts. and Roy Morgan of Hollywood is planning a well for the 2100 block on West Anaheim.

Eight wells were completed in the field, three by Union Pacific, two by Signal Oil Co., and one each by General Petroleum Corp., Allied Petroleum Corp. and Padreson Oil Co. Of the group, the last two were the most interesting. Allied's No. 31, located south of Anaheim in the gas plant area, obtained an initial flow of 250 bbls. a day clean 16.0 gravity oil through a 20/64 in. bean from a total depth of 3353 ft. Flow pressure was 185 lbs. Padreson's well, at the corner of Opp and Marine in Wilmington, was finished with a "prepack" liner landed at 3670 ft. flowing at the estimated rate of 420 bbls. a day.

## Outpost Failures End Torrance Boom

Failure of King Petroleum Co. and Riviera Petroleum Co. to find productive sands at the extreme southeast end of the Torrance "Hot Spot", together with the poor showing of Deep Hole Drilling Co.'s No. 2 at 242nd St. and Eshelman, have definitely outlined the Del Amo zone play, and to all intents and purposes have ended the present boom. Although many wells, mostly in fairly good locations, are yet drilling or being completed, only one new rig has recently been built, that for D & J Oil Co. on the east side of Eshelman south of 235th St.

Chiefly responsible for the sudden cessation of new work was the suspension of drilling in the Riviera well at 5369 ft. and the abandoning of King No. 1 at 5198 ft. Neither well encountered oil in the Del Amo.

Of the 14 wells lately placed on production, only a few appear to have a chance of repaying drilling costs; the best of the group being Harry Rilling's No. 1 on the west side of Walnut between 237th and 238th Sts. With 410 ft. of formation open, the well was swabbed in flowing at the rate of 625 bbls. of clean oil a day. Bottom of the hole is 5170 ft.

Water is becoming a serious menace to the entire area, practically all wells, including new completions, showing high cuts. The field, at the present time, appears to be "washed up," as it did last August with the collapse of the Pennsylvania Ave. boom, but many observers believe that spasmodic drilling outbreaks may be expected for some time yet. The Torrance field is large in area and several sections remain unprospected for deeper production.

## Texas Abandons Anaheim Wildcat

The fourth major company attempt in less than three years to develop an oil field in the Anaheim area ended in failure with the recent abandonment of The Texas Co.'s No. A-13-1, located in sec. 8,4-10, west of the city. Some encouragement was felt when oil sands were reported in the intervals 7785-7820 ft. and 7885-7915 ft., but formation tests proved the sands nonproductive and the hole was carried to 8977 ft. with no further showings.

Despite the failure of three Shell Oil Co. tries, as well as The Texas Co.'s., it is probable that at least one more wildcat will test the area in the not too far distant future. Each well, to date, has encountered encouraging showings, and each has contributed its share to complete the geological picture.

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## 2nd Aliso Canyon Well Completed By T. W. A.

With an initial production of 675 bbls., later increased to a potential of nearly 1100 bbls., Tide Water Associated Oil Co. completed the second well in the Aliso Canyon field it discovered last fall. The well, Porter No. 2, located west of the discovery, No. 1, intersected the Santa Susana thrust fault as did the first well, and with bottom at 5200 ft. was brought in from 575 ft. of Pliocene formations. Like Porter No. 1, pressures and gas yield are relatively low.

Standard Oil Co. Ward No. 1, a northerly offset to the Porter lease is drilling in shale and oil sand at 5744 ft. After entering Pliocene formations at 5250 ft. Union Oil Co.'s Santa Susana Orchid No. 27-1, located to the east, is preparing to core ahead after cementing a protection string at 5084 ft.

## 2nd Deep Test Looms For Signal Hill Field

With the avowed intent of drilling another 10,000 ft. well in the Signal Hill oil field, R. W. (Rocky) Jerman is launching a new concern to be called the Dormax Oil Co. Location for the new test, on 25th St. east of Walnut Ave., is considered by most engineers to be more favorable than that of De Soto Oil Co. No. 1, Mr. Jerman's first effort to develop a super deep zone in the Long Beach old field.

De Soto No. 1, situated on Gundry Ave. north of Hill St., was completed from a 400 ft. interval open to 10,157 ft. flowing by gas lift at a 350 bbl. rate. After four months, production remains unchanged and free of water.

## Bartholomae, Union Drill E. Coyote Wells

Two new wells are being started in the westerly section of the East Coyote field, one each by Bartholomae Oil Corp. and Union Oil Co. Bartholomae's new well will be known as Stern No. 8 and will be drilled under the supervision of the company's engineer, Don Riley, who surprised the industry last fall by completing Stern No. 7 flowing 700 bbls. a day; a notable achievement in what is generally considered an old and depleted field.

Union Oil Co., for some time inactive in East Coyote, has the derrick up for No. 21 on its large Hole lease.

## Five Points Well Still Unproductive

Dragon Oil Co.'s Huntington Beach Five Points well, now operated by Thompson & Gieske of Long Beach, has yet failed to produce any oil, though the hole has been cleaned out, plugged, and water witched.

Offsetting J.E.F. Oil Co.'s Bruce No. 1, producing well, Petromont Oil Corp. has built a derrick. The location is considered semi-proved.

In the ocean front sector, Southwest Exploration Co. completed No. 11 for 300 bbls. and is about to put No. 15 on the beam.

## Fernando Oils, Ltd. Plans Test of Chatsworth Area

The first company to prospect the San Fernando Valley following Tide Water Associated's discovery of the Aliso Canyon field will be Fernando Oils, Ltd. which is now awaiting the Los Angeles City Planning Commission's OK to drill at Chatsworth. Location for the new test will be at the intersection of Lassen and Canoga Sts.

### NORTHERN COUNTIES WILDCATS

| County | Well | No. | Section | Depth | Status |
|---|---|---|---|---|---|
| Monterey | Anderson, A. A., Hillman | 1 | 15, 24-14 | 4004 | Idle |
| | The Texas Co., Arroyo Seco | 1 | 11, 19-15 | 3115 | Drilling |
| Santa Cruz | Faria, Joseph Jr. | 1 | 12, 11-3 | | Location |
| | Hatcher, Homer | 1 | 8, 9-1 | | Location |
| Stanislaus | Santa Maria Pet. Co. | 1 | 34, 1-10 | 2310 | Idle |
| Sutter | Buttes Oilfields, Inc. | 5 | 1, 15-1 | | Rigging up |

### COASTAL COUNTIES WILDCATS

| Area | Well | No. | Section | Depth | Status |
|---|---|---|---|---|---|
| **Santa Barbara County** | | | | | |
| Capitan | Litho Oil Co., Rhode I. | 1 | 4, 4-30 | 2510 | Drilling |
| Carreaga | Barbara Pacific Oil Co. | A-A 2 | 8, 8-33 | 6373 | Deepening |
| Carpinteria | Western Oil Royalties | 1 | 32, 4-25 | 2023 | Testing |
| Foxen Canyon | Richfield Oil Corp., Tinaquaic | 1 | 36, 9-32 | 5324 | Drilling |
| Gaviota | Gaviota Oil Co., Hollister | 1 | 35, 5-33 | 3215 | Idle |
| Gato Ridge | Barnsdall Oil Co., Mag. | 5 | 9, 8-32 | 4385 | Producing |
| | Pezzoni | 1 | 15, 8-32 | 4494 | Idle |
| | The Petrol Corp., Tognazzini | 32-A | 9, 8-32 | 2933 | Drilling |
| Goleta Gas Area | Gen. Pet. Corp., More | 4 | 15, 4-25 | | Rigging up |
| Guadalupe | Cole, Fred Ferrini | 1 | 15, 10-35 | | Rig |
| Los Olivos | General Petroleum Corp., Chamberlin | 1 | 12, 7-31 | 4310 | Abandoned |
| | United Western Oil Co. | 1 | 15, 7-30 | 3540 | Drilling |
| San Marcos | Richfield O. Corp., San Marcos | 1 | 20, 6-29 | 889 | Drilling |
| Summerland | Garman Oil Co. | 17-1 | 22, 4-6 | 1487 | Idle |
| | Glenray Oil Co., Glenray | 1 | 1, 4-26 | 75 | Drilling |
| | Oil Group, Inc., Hyland | 1 | 16, 4-26 | 1315 | Idle |
| **San Luis Obispo County** | | | | | |
| Edna | Loma Grande Oil Co., Lewis | 1 | 28, 31-13 | 2125 | Idle |
| Elk Horn | Calif. Pet. Prod., Irons | 1 | 19, 10-24 | 2200 | Drilling |
| | Newton, S. M., Stafford | 1 | 18, 31-21 | 2350 | Drilling |
| | Temblor Oil Co. | 1 | 22, 31-21 | 3465 | Prep. to resume |
| Huasna | Hancock O. Co., Scherer-Dickes | 1 | 30, 12-33 | 5593 | Idle |
| Paso Robles | Vanguard Oil Co., Clark | 1 | 26, 27-14 | 4951 | Idle |
| | Epco, Inc. | 1 | 27, 26-13 | 5180 | Drilling |
| **Ventura County** | | | | | |
| Ojai | High Mesa Oil Co. | 1 | 16, 4-22 | 1770 | Abandoned |
| Red Mountain | Martin, J. W. | 3 | 15, 4-21 | 1260 | Idle |
| Sespe | Brain Oil Co., Cosby | 1 | 14, 4-19 | 1120 | Idle |
| | Carlan Oil Co., Hardison | 1 | 22, 4-20 | 2940 | Idle |
| | English, J. A. | 2 | 13, 4-19 | 450 | Drilling |
| | Merchants Pet., Cochran | 8 | 1, 4-20 | 1885 | Drilling |
| | Nevada-Fortuna Oil Co. | 1 | 13, 4-19 | | Rig |
| | Renard Oil Co. | 1 | 6, 4-19 | | Rigging rotary |
| Shiells Canyon | Galveston Oil Co. | 1 | 5, 3-19 | 935 | Drilling |
| | Shomy Oil Co., Shomy | 1 | 32, 4-19 | 700 | Drilling |
| South Mt. | Clipper Oil Co. | 1 | 17, 3-20 | | Rig |
| Tar Creek | Section 20 Oil Co. | 1 | 20, 5-19 | 2630 | Drilling |
| Timber Canyon | Stallings, Senter, Ahlberg | 1 | 24, 4-21 | 1445 | Idle |
| Ventura | Ventura Drilling Co. | 1 | 10, 3-23 | 2285 | Idle |
| | Ventura Exploration Co., Sexton | 1 | 30, 3-22 | 9511 | Idle |
| Wheeler Canyon | P & M Oil Co. | 1 | 24, 4-22 | | Grade |

# Coastal District

## Santa Maria Valley Well Shows Big Production

Reminiscent of a year ago when sec. 27,10-34 was truly the "Hot Spot" of the Santa Maria Valley field, Gerard & Thompson completed Berneiser No. 1 at 4970 ft. flowing 3385 bbls. of 14 gravity clean oil. Open to production is a 445 ft. interval of the Monterey, drilling being stopped at the top of the Franciscan schist.

Due to the somewhat unfavorable marketing conditions prevailing in the field, all other wells are either idle or closed in to minimum yields.

## Alliance Completing Ventura Avenue Well

Having drilled one of the straightest and cleanest holes in the Ventura Ave. field, Alliance Petroleum Corp. is preparing to complete Hisey No. 3 at approximately 8500 ft. Water string, 8⅝ in., was cemented at 7750 ft. below which much good oil sand was cored. The well adjoins General Petroleum's Barnard No. 18 which discovered the zone last summer.

## Three Wells Active In Carrizo Plains

With three wells working, more activity is in evidence in the Carrizo Plains area than at any time in recent years. This little traveled section of San Luis Obispo county is again coming to the attention of oil men who hope to obtain production at relatively shallow depths because of the as yet unconfirmed tales of showings obtained in the three wells now working.

California Production Co. is deepening its Irons No. 1, having at latest reports reached 2200 ft., while S. M. Newton is drilling with cable tools at 2350 ft. The projects are located respectively in sec. 19,10-24 and sec. 18,31-21. In sec. 22,31-21, Temblor Oil Co. of California is preparing to deepen its No. 1 which has been standing idle at 3465 ft.

## Wildcatters Busy In Ventura County

With the coming of spring weather, wildcats, like wildflowers, spring up in Ventura county. Near Shiells Canyon, Galveston Oil Co. is drilling its sec. 5, 3-19 well below 1000 ft. while Shomy Oil Co. is down 700 ft. Within the proved Shiells Canyon field, The Texas Co. is drilling Shiells No. 137 at 980 ft.

J. A. English is drilling his Lankershim No. 2 below 450 ft. in Hopper Canyon. Adjoining the English project, Nevada-Fortuna Oil Co. has a derrick up for Hadley No. 1. Seeking to extend its Sespe production, Merchants Petroleum Co. is drilling Cochrane No. 8 at 1900 ft. At Tar Creek, Section 20 Oil Co. is drilling ahead at 2636 ft. after failing to shut off water with 8⅝ in. casing cemented at 2537 ft.

## 130 Bbl. Well For Steel Island

Rincon Development Co. recently brought in its Permit No. 82-4 at Rincon pumping 130 bbls. a day. The well is the fourth to be drilled by various companies on the steel island built in the bay a quarter of a mile from shore. Directionally drilled toward the south property line, the hole was bottomed at 2077 ft. Only 20 ft. of formation is open, the water string being cemented at 2057 ft. The oil is free of water and tests better than 28 gravity.

## Richfield Spuds San Marcos Core Hole

Starting what may become a comprehensive core holing campaign, Richfield Oil Corp. has spudded its San Marcos No. 1 in sec. 20,6-29. But few tests have been made of this area and Richfield's results will be awaited with unusual interest. The company plans a deep test if evidences of structure are revealed by the core holes.

## Work Starting On More Gasser

Terminating a long interval of dormancy, work is starting on a new well for the More Ranch gas field on the coast near Goleta. The new project, to be known as More No. 4, will be drilled by General Petroleum Corp., discoverer of the field.

## Petrol Tognazzini Sets Water String

The Petrol Corp. is setting a water string in its current Gato Ridge project, Tognazzini No. 32-A. Bottomed for the time being at 2800 ft., the Monterey chert zone was cored at 2375 ft. Classed as non-refinable crude due to its high viscosity and sulfur content, the oil from Petrol's extensive Gato Ridge holdings is shipped by tanker to east coast markets where refineries are not overstocked with heavy oils.

## Derrick Erected For Ferrini Test

A mile south of the town of Guadalupe, Fred E. Cole of Santa Barbara has erected a rig on the large Ferrini property. Much interest has been shown in the new project, especially as only a year ago a syndicate of major companies was on the point of drilling a joint test on the same lease when negotiations fell through. Mr. Cole, who has drilled many wells in Santa Barbara county, is reported backed in this venture by Hollywood financial interests. The well is scheduled to test the Monterey formation which is productive in the Santa Maria Valley field a short distance to the east.

## Barbara Pacific Deepens Arnold-Apache at Carreaga

Barbara Pacific Oil Co., a new concern made up of Long Beach capital, has taken over the old Arnold-Apache well in the Carreaga area of Santa Barbara county, and is sidetracking the liner preparatory to deepening.

Located a mile south of the old Santa Maria field in sec. 8,8-33, the well was drilled two years ago to 6375 ft. where it was completed pumping 75 bbls. a day with considerable water. Last year Douglas-Stratton Oil Co. drilled a little higher on the structure obtaining, after much difficulty shutting off water, a slightly better well at greater depth.

Producing formation in the two wells is the Monterey shale, the most prolific horizon in this section of the county.

## G. P. Abandons Chamberlin No. 1

Chamberlin No. 1, General Petroleum Corp.'s second Los Olivos try in recent months, has been abandoned at 4310 ft. The well was located in projected sec. 12,7-31, approximately three miles north of the town of Los Olivos.

General Petroleum's last previous attempt to develop production in this area was La Laguna No. 1 which drilled unsuccessfully to 3834 ft. in sec. 6,7-30. Both wells sought productive horizons in the Monterey.

## Field Deepens Old Wildcat Well

Oliver C. Field, veteran coast operator, is preparing to deepen his long suspended wildcat in sec. 21,9-33. Located a mile east of the old Santa Maria field, the well is 5456 ft. deep with 10¼ in. casing cemented at 2800 ft.

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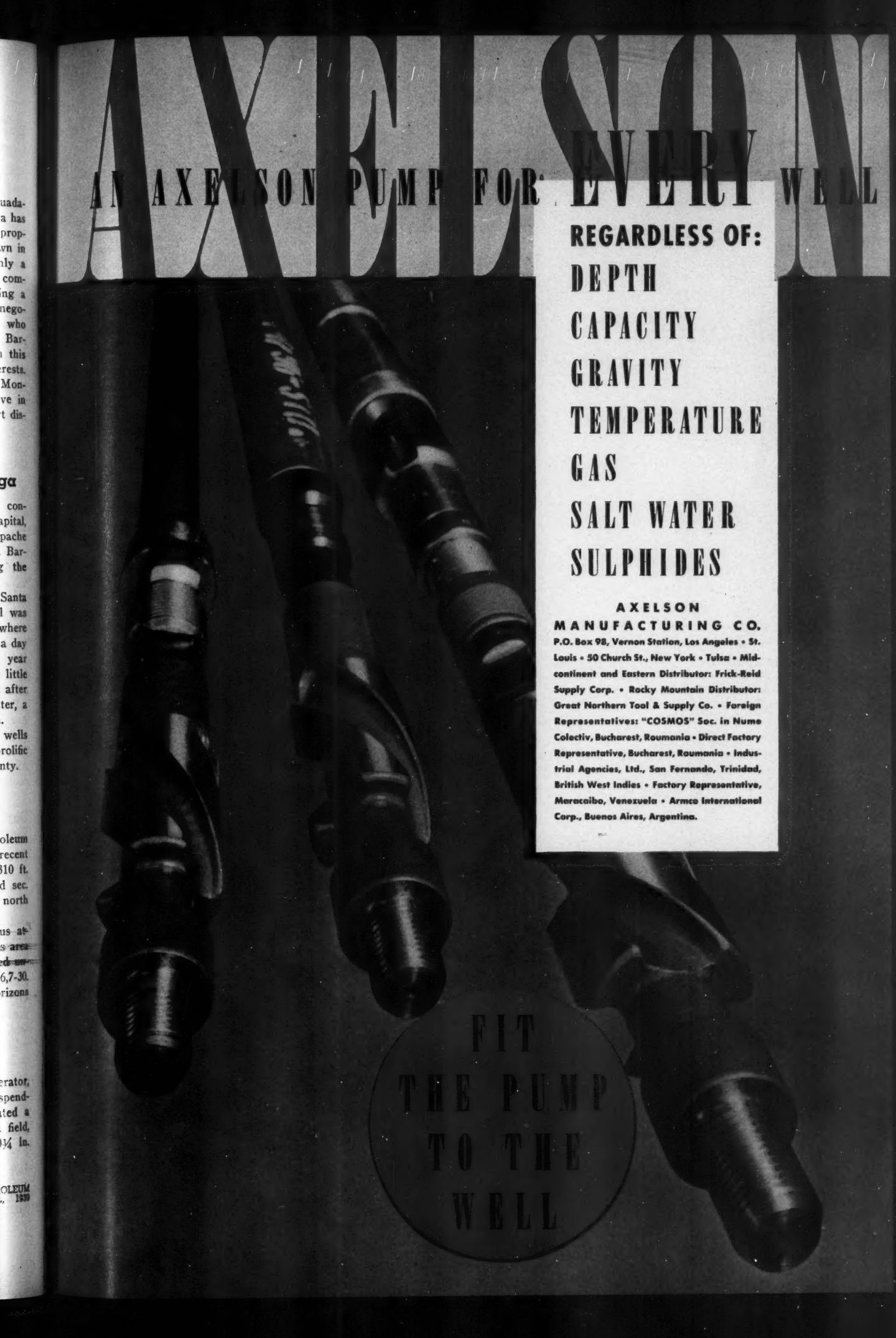


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(Continued from Page 24)

other than that employed in the experimental work, may be estimated from Equation 5 using a correlation of the energy rejected to the jacket as a function of operating conditions to predict the heat associated with the process. In this instance it is assumed that the heat transfer occurring is primarily a function of the configuration of the flow channels and the mean temperature difference existing between the fluid and the cylinder wall. Before Equation 5 can be evaluated it is necessary to predict the outlet temperature by the trial solution of Equation 14. It should be realized that the work derived from Equation 5 will include all of the frictional effects involved with the exception of those losses of mechanical energy occurring outside of the cylinder.

It is believed that this procedure is of engineering value since many machines of the same type are used on a variety of fluids and it is often of interest to determine the change in operating conditions resulting from the use of a gas of different composition. However, before any of these methods are of practical value, thermodynamic data concerning a variety of hydrocarbon gases must be available throughout the range of temperatures and pressures encountered in industrial compression practice.

## THERMODYNAMIC PROPERTIES OF HYDROCARBON GASES

The foregoing thermodynamic analysis of the compression of gases indicates the utility of factual information concerning the thermodynamic properties of these materials. Unfortunately, natural gases contain a large number of components and the possible ramifications of compositions that are encountered in industrial practice are very large. At the present time there is little experimental information available concerning the thermodynamic behavior of natural gases, especially in the range of the temperatures which are sometimes encountered at the end of the compression process. Experimental work is available concerning the thermodynamic properties of a relatively dry (88 per cent methane) natural gas at temperatures from 700 to 2500 F. for pressures up to 3000 pounds per square inch[1]. Experimental measurements have also been reported for a somewhat richer (83 per cent methane) natural gas throughout the same temperature and pressure intervals[2]. In addition, Edmister[3] evaluated the thermodynamic properties of methane throughout a wide range of temperatures and pressures. These data, although helpful, cover but a few cases and it will require a great many more experimental results than are at present available to permit accurate prediction of the thermodynamic properties of hydrocabon gases throughout the range of conditions that are encountered in industrial compression practice.

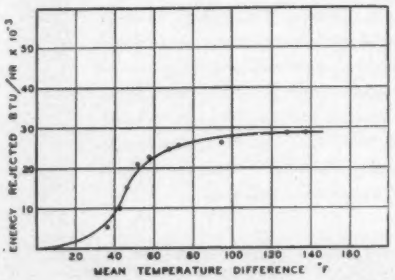


Figure 6. Energy Rejected to Jacket as a Function of the Mean Temperature Difference between Gas and Jacket Water.

Information concerning the behavior of binary gaseous hydrocarbon systems is of value in approximating the properties of more complex naturally occurring gases. In this connection, mixtures of methane and ethane appeared to be of importance since both of these components are found in substantial quantities in nearly all naturally occurring hydrocarbon gases. The authors have investigated[4] the thermodynamic behavior of this system throughout the entire range of compositions at temperatures from 700 to 2500 F. for pressures as high as 4750 pounds per square inch. These data were presented in terms of the partial[5] thermodynamic properties of methane and ethane and although for many purposes this form of presentation is desirable, the properties of the various mixtures themselves are more directly applicable in connection with gas compression problems than are the partial quantities.

The form of presentation employed by Keenan and Keyes[6] in their depiction of the thermodynamic properties of water is admirable but requires approximately twenty pages of tabulations to describe the behavior of superheated water vapor within the range of conditions covered by the experimental work on methane and ethane. It appeared desirable therefore, to employ "residual" methods in the presentation of these data. In general, a residual quantity represents the difference between an analytical representation which approximates the behavior and the actual value.

In the case of specific volumes, the perfect gas laws approximate roughly the behavior of gases at states significantly removed from the critical point and the two-phase region and therefore, it may be used to advantage as a reference basis. Under these circumstances the residual specific volume of a gaseous mixture is related to the specific volume by the following equation:

$$V = \frac{(n_1 b_1 + n_2 b_2 + \ldots n_n b_n)T}{P} - \underline{V} \qquad (16)$$

In the case of the methane-ethane system the specific volume may be evaluated from a knowledge of the residual volume and the prevailing temperature, pressure and composition by the relation:

$$V = [0.3566 + 0.3118 n_1] \frac{T}{P} - \underline{V} \qquad (17)$$

The residual volume for this system has been recorded in Table 1 as a function of pressure and temperature for two mixtures of methane and ethane together with similar data concerning the volumetric behavior of methane[7]. From an inspection of the table it is seen that the residual volume is finite at zero pressure and does not vary greatly with pressure or temperature. It is possible, therefore, to interpolate the data with relatively high accuracy from a small number of tabulations.

The enthalpy (often called heat content or total heat) of gaseous mixtures is a function of the pressure, temperature and composition. However, the variations in enthalpy with pressure are not, in general, as large as those due to variations in temperature for the changes in state usually encountered in industrial compressor operations. It is advantageous to employ residual methods in the representation of this quantity. The residual enthalpy values recorded in Table 1 are related to the specific enthalpy by means of the following equation, which requires information concerning the temperature and composition in addition to the residual enthalpy for its solution:

$$H = (0.47 + 0.10 n_1)(t - 60) - \underline{H} \qquad (18)$$

The enthalpy obtained from Equation 18 is based upon an arbitrary datum value of zero for the methane and ethane in the pure state at infinite attenuation and at a temperature of 60° F. It should be realized that these enthalpy values take into account changes in composition as well as changes in temperature and pressure.

The entropy of a gas varies rapidly with the temperature and pressure. It is necessary, therefore, to take into account the variation in both of these parameters in developing a suitable reference entropy for the solution of compressor problems. An arbitrary datum state for each component has been chosen by setting the entropy of each one equal to its residual entropy at a pressure of 3500 pounds per square inch and 60° F. This reference state was chosen because of the positive values of entropy resulting from its use. It should be realized that since only differences in entropy are of importance in most engineering calculations the exact choice of a reference state is of little importance except in connection with the convenience of tabulation and use. Equation 19 presents the relationship between the entropy of one pound of any given mixture within the methane-ethane system and the prevailing pressure, temperature, composition and the residual entropy, values of which are recorded in Table I

$$8x10^3 = (0.16t - 9.6)n_1 + 0.76t - 45.6 + (132.7n_1 + 151.9)\log\frac{3500}{P} - \underline{S}x10^3 \qquad (19)$$

It is realized that Equation 19 is somewhat complex but it is believed that it represents as simple a correlation as is consistent with the accuracy of interpolation desired. Equation 19 is restricted to the methane-ethane system since the necessary numerical constants applying to this system have already been incorporated in the terms of this equation.

It is believed that the residual volumes recorded in Table 1 will permit the evaluation of the specific volume of mixtures of methane and ethane with an uncertainty of not more than 0.4 per cent throughout the range of conditions covered by the data. The values of enthalpy and entropy derived from the corresponding residual quantity probably do not involve uncertainties greater than 1 per cent.

In order to illustrate the use of the residual methods that have been described, the specific volume, enthalpy and entropy of a mixture of methane and ethane containing 84.6 weight per cent methane (91.1 mol per cent methane) at a temperature of 186° F. for a pressure of 294 pounds per square inch have been interpolated from Table I. By means of linear interpolation the following residual quantities were obtained for this state: residual specific volume 0.0320 cubic feet per pound; residual enthalpy 9.00 B.t.u. per pound; residual entropy —0.00137 B.t.u. per pound °F. absolute. It is realized that linear interpolations introduce uncertainty in the estimation of the residual quantities for the state in question, but it is believed that they are sufficiently small that they do not introduce significant uncertainties in the final result. By the application of Equations 17, 18 and 19 the corresponding values for the specific properties were found to be as follows: specific volume 1.3303 cubic feet per pound; enthalpy 60.88 B.t.u. per pound; entropy 0.3983 B.t.u. per pound per °F. absolute. Graphical interpolation of the residual volumes from the information submitted in Table I gave a value of 0.0322 cubic feet per pound for the residual specific volume which is undoubtedly somewhat more accurate than that obtained by the linear interpolation process. The corresponding specific volume as determined from Equation 17 was found to be 1.3301 cubic feet per pound. The use of linear interpolative methods introduced a possible uncertainty of approximately 0.02 per cent in the resulting specific volume. This error would be larger at higher pressures.

The use of a binary gaseous hydrocarbon system as representative of the conditions obtaining in complex hydrocarbon mixtures is open to many uncertainties and is undesirable unless better information is lacking. However, it is believed that the use of values for a mixture of methane and ethane having the same average molecular weight as the gas in question will yield results which are sufficiently descriptive of actuality to be of engineering value. In order to illustrate the magnitude of these divergences, the compressibility factor is presented for two natural gases at 160° F. as a function of the average molecular weight for each of a series of pressures in the accompanying Figure 7. The full curves represent the behavior of mixtures of methane and ethane. It is seen that when they are compared on the basis of the same average molecular weight these binary mixtures at pressures below 1000 pounds per square inch absolute do not deviate more than 2 per cent from the corresponding values for the natural gases. At the higher pressures deviations amount to as much as 5 per cent and for each of the natural gases shown in Figure 7 the compressibility factor is larger than the corresponding one for a binary mixture of methane and ethane of the same average molecular weight. It is believed however, that these data for methane-ethane mixtures may be used as a first approximation of the behavior of complex natural gases which do not contain large quantities of heavier components.

## APPLICATIONS

In order to illustrate the applicability of these methods the performance of a compressor operating upon hydrocarbon gases has been predicted and compared with that found by experiment. This comparison indicates the overall accuracy of the method including the discrepancies involved by the use of the thermodynamic data for mixtures of methane and ethane to describe the behavior of complex hydrocarbon gases of the same average molecular weight. The specific example available concerned the compression of a hydrocarbon gas at relatively low pressures and under these conditions relationships based upon the perfect gas laws would approximate the behavior much closer than would be expected at higher pressures where hydrocarbon gases deviate significantly from perfect gas behavior.

**General Conditions:** The compressor employed for the experimental work* was an 11½" by 20" single-stage Cooper Compressor operating at 200 r.p.m. with approximately 8.4 per cent clearance. The gas employed exhibited the following analysis

* This experimental work was done as a part of the activities of the Gas Engine and Compression Committee of the C.N.G.A. and was covered by a report submitted by L. F. Scheel, Chairman, October 21, 1936.

(1) Sage and Lacey, Ind. Eng. Chem., 28, 240 (1936)
(2) Sage and Lacey, Oil and Gas Journal, 35, No. 26, 176 (1936); Drilling and Production Practice 1936, p. 158, A.P.I. New York 1937.
(3) Edmister, Ind. Eng. Chem., 28, 1112 (1936).
(4) Sage and Lacey, Ind. Eng. Chem., 31, 000 (1939).
(5) Lewis, Proc. Am. Acad. Arts Sci., 43, 273 (1907).
(6) Keenan and Keyes, Thermodynamic Properties of Steam, p. 40, John Wiley and Sons, New York, 1936.
(7) Kvalnes and Gaddy, Jr. Am. Chem. Soc., 53, 398 (1931).

expressed as volume per cent: Methane 90.2, Ethane 4.6, Propane 3.4, Isobutane 0.7, n-Butane 1.0, n-Hexane 0.1 which is equivalent to a calculated gasoline content of 0.374 gallons per thousand cubic feet and has an average molecular weight of 18.41 During the course of the experimental work the inlet and discharge temperatures and pressures were determined as well as the gas

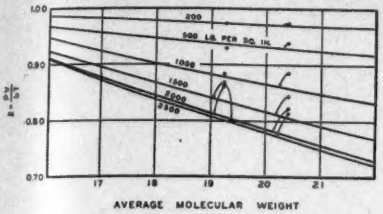


Figure 7. Compressibility Factor of Gases at 160° F. as a Function of their Average Molecular Weight.

temperature at the discharge value. This latter quantity was ascertained by means of a thermocouple mounted at this point. The energy rejected to the jacket was evaluated from a knowledge of the quantity of the cooling water and its temperature rise. The gas rate was determined and indicator cards were obtained for each set of conditions. These results for three sets of conditions are recorded in Table II and the corresponding "head end" indicator cards are depicted in Figure 8.

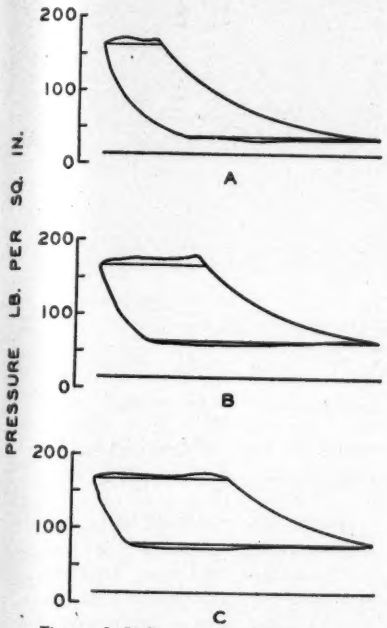


Figure 8. Indicator Cards for the Three Tests.

**Estimation of Maximum Temperature:** In order to indicate the relative accuracy of prediction of the gas temperature attained at the outlet of the compressor, this quantity has been determined by the application of Equation 15. The solution of this equation requires only information concerning the energy rejected to the jacket in the form of heat per unit weight of fluid compressed.

The entropy corresponding to the outlet pressure has been computed from the data submitted in Table I and has been plotted for the first set of conditions in Figure 9 over a range of temperatures. In addition, the state corresponding to the inlet conditions has also been indicated on this diagram for the first set of conditions and is recorded for all three sets in Table II. The solution of Equation 15 gives values of the temperature corresponding to the state **B** indicated in Figure 9. These estimated outlet temperatures together with the corresponding values of entropy have been recorded in a part of Table II for the three sets of operating conditions.

For comparison, values of the outlet temperature were calculated upon the assumption of isentropic

**TABLE I**

**RESIDUAL THERMODYNAMIC PROPERTIES OF MIXTURES OF METHANE AND ETHANE WEIGHT PER CENT METHANE AS FOLLOWS**

| Temp. °F. | Pressure Lb/sq. in. Absolute | 60% V | 60% H | 60% S | 80% V | 80% H | 80% S | 100% V | 100% H | 100% S |
|---|---|---|---|---|---|---|---|---|---|---|
| 70 | 0 | 0.0624 | 0.47 | -0.0313 | 0.0541 | 0.44 | -0.0148 | 0.0449 | 0.41 | -0.0009 |
| | 250 | 0.0643 | 9.40 | -0.0089 | 0.0544 | 8.24 | 0.0046 | 0.0443 | 7.30 | 0.0160 |
| | 500 | 0.0653 | 19.15 | 0.0152 | 0.0544 | 16.66 | 0.0254 | 0.0436 | 14.71 | 0.0338 |
| | 750 | 0.0652 | 29.87 | 0.0412 | 0.0542 | 25.58 | 0.0469 | 0.0424 | 24.60 | 0.0563 |
| | 1000 | 0.0647 | 41.33 | 0.0685 | 0.0535 | 34.92 | 0.0693 | 0.0410 | 34.50 | 0.0786 |
| | 1250 | 0.0635 | 52.94 | 0.0960 | 0.0521 | 44.45 | 0.0918 | 0.0393 | 42.06 | 0.0964 |
| | 1500 | 0.0613 | 64.01 | 0.1224 | 0.0501 | 53.93 | 0.1142 | 0.0374 | 49.41 | 0.1136 |
| | 1750 | 0.0575 | 73.92 | 0.1463 | 0.0474 | 63.00 | 0.1356 | 0.0353 | 56.38 | 0.1300 |
| | 2000 | 0.0523 | 82.17 | 0.1672 | 0.0438 | 71.34 | 0.1553 | 0.0329 | 62.91 | 0.1453 |
| | 2250 | 0.0467 | 88.86 | 0.1842 | 0.0392 | 78.61 | 0.1727 | 0.0301 | 68.91 | 0.1594 |
| | 2500 | 0.0410 | 94.38 | 0.1984 | 0.0358 | 84.94 | 0.1880 | 0.0272 | 74.31 | 0.1720 |
| | 2750 | 0.0358 | 98.94 | 0.2104 | 0.0317 | 90.29 | 0.2010 | 0.0242 | 79.06 | 0.1833 |
| | 3000 | 0.0312 | 102.60 | 0.2202 | 0.0280 | 94.74 | 0.2120 | 0.0211 | 83.15 | 0.1937 |
| | 3250 | 0.0269 | 105.38 | 0.2280 | 0.0243 | 98.39 | 0.2212 | ..... | 86.62 | 0.2012 |
| | 3500 | 0.0231 | 107.30 | 0.2337 | 0.0207 | 101.34 | 0.2287 | ..... | 89.55 | 0.2082 |
| 100 | 0 | 0.0558 | 1.65 | -0.0326 | 0.0484 | 1.56 | -0.0165 | 0.0379 | 1.47 | -0.0028 |
| | 250 | 0.0567 | 9.53 | -0.0139 | 0.0481 | 8.47 | -0.0001 | 0.0373 | 7.67 | 0.0114 |
| | 500 | 0.0570 | 24.39 | 0.0060 | 0.0476 | 15.83 | 0.0170 | 0.0366 | 14.29 | 0.0263 |
| | 750 | 0.0567 | 27.07 | 0.0268 | 0.0469 | 23.58 | 0.0347 | 0.0357 | 21.09 | 0.0414 |
| | 1000 | 0.0560 | 36.49 | 0.0483 | 0.0459 | 31.56 | 0.0528 | 0.0344 | 27.89 | 0.0565 |
| | 1250 | 0.0548 | 46.04 | 0.0700 | 0.0444 | 39.63 | 0.0710 | 0.0329 | 34.56 | 0.0711 |
| | 1500 | 0.0528 | 55.44 | 0.0912 | 0.0425 | 47.63 | 0.0889 | 0.0313 | 41.03 | 0.0845 |
| | 1750 | 0.0497 | 64.27 | 0.1112 | 0.0401 | 55.45 | 0.1062 | 0.0294 | 47.21 | 0.0989 |
| | 2000 | 0.0459 | 72.23 | 0.1294 | 0.0373 | 62.76 | 0.1225 | 0.0274 | 53.03 | 0.1116 |
| | 2250 | 0.0416 | 79.09 | 0.1453 | 0.0343 | 69.33 | 0.1372 | 0.0251 | 58.40 | 0.1234 |
| | 2500 | 0.0372 | 84.81 | 0.1588 | 0.0311 | 75.10 | 0.1502 | 0.0227 | 63.29 | 0.1341 |
| | 2750 | 0.0329 | 89.52 | 0.1701 | 0.0279 | 80.07 | 0.1615 | 0.0201 | 67.69 | 0.1437 |
| | 3000 | 0.0289 | 93.36 | 0.1795 | 0.0248 | 84.32 | 0.1713 | 0.0176 | 71.63 | 0.1523 |
| | 3250 | 0.0254 | 96.43 | 0.1872 | 0.0218 | 87.90 | 0.1796 | ..... | 75.09 | 0.1599 |
| | 3500 | 0.0222 | 98.82 | 0.1934 | 0.0186 | 90.91 | 0.1866 | ..... | 78.10 | 0.1664 |
| 130 | 0 | 0.0502 | 2.43 | -0.0333 | 0.0433 | 2.32 | -0.0172 | 0.0322 | 2.21 | -0.0037 |
| | 250 | 0.0497 | 9.45 | -0.0175 | 0.0428 | 8.62 | -0.0032 | 0.0317 | 7.81 | 0.0083 |
| | 500 | 0.0494 | 16.97 | -0.0008 | 0.0420 | 15.16 | 0.0112 | 0.0310 | 13.76 | 0.0208 |
| | 750 | 0.0489 | 24.93 | 0.0166 | 0.0410 | 21.94 | 0.0260 | 0.0300 | 19.82 | 0.0335 |
| | 1000 | 0.0483 | 33.13 | 0.0343 | 0.0398 | 28.83 | 0.0408 | 0.0289 | 25.83 | 0.0460 |
| | 1250 | 0.0472 | 41.40 | 0.0523 | 0.0382 | 35.74 | 0.0556 | 0.0275 | 31.65 | 0.0581 |
| | 1500 | 0.0455 | 49.58 | 0.0695 | 0.0363 | 42.58 | 0.0701 | 0.0260 | 37.23 | 0.0697 |
| | 1750 | 0.0431 | 57.48 | 0.0864 | 0.0342 | 49.21 | 0.0841 | 0.0243 | 42.53 | 0.0806 |
| | 2000 | 0.0401 | 64.83 | 0.1022 | 0.0318 | 55.50 | 0.0974 | 0.0226 | 47.38 | 0.0907 |
| | 2250 | 0.0366 | 71.44 | 0.1164 | 0.0293 | 61.26 | 0.1096 | 0.0207 | 52.08 | 0.1040 |
| | 2500 | 0.0331 | 77.14 | 0.1286 | 0.0268 | 66.46 | 0.1206 | 0.0187 | 56.49 | 0.1094 |
| | 2750 | 0.0284 | 84.01 | 0.1429 | 0.0242 | 71.08 | 0.1304 | 0.0166 | 60.57 | 0.1177 |
| | 3000 | 0.0256 | 88.01 | 0.1519 | 0.0217 | 75.14 | 0.1391 | 0.0145 | 64.31 | 0.1252 |
| | 3250 | 0.0229 | 91.36 | 0.1595 | 0.0190 | 78.65 | 0.1466 | ..... | 67.67 | 0.1320 |
| | 3500 | 0.0204 | 94.18 | 0.1720 | 0.0163 | 81.65 | 0.1531 | ..... | 70.65 | 0.1379 |
| 160 | 0 | 0.0444 | 2.84 | -0.0332 | 0.0389 | 2.73 | -0.0172 | 0.0278 | 2.63 | -0.0037 |
| | 250 | 0.0446 | 9.13 | -0.0197 | 0.0381 | 8.48 | -0.0086 | 0.0272 | 7.74 | -0.0066 |
| | 500 | 0.0440 | 15.82 | -0.0191 | 0.0372 | 14.41 | 0.0073 | 0.0265 | 13.13 | 0.0173 |
| | 750 | 0.0431 | 22.83 | 0.0090 | 0.0361 | 20.47 | 0.0198 | 0.0255 | 18.58 | 0.0290 |
| | 1000 | 0.0422 | 30.04 | 0.0238 | 0.0348 | 26.58 | 0.0323 | 0.0243 | 23.93 | 0.0385 |
| | 1250 | 0.0410 | 37.34 | 0.0387 | 0.0332 | 32.66 | 0.0447 | 0.0230 | 29.91 | 0.0486 |
| | 1500 | 0.0394 | 44.60 | 0.0534 | 0.0313 | 38.61 | 0.0567 | 0.0215 | 34.03 | 0.0582 |
| | 1750 | 0.0373 | 51.68 | 0.0677 | 0.0295 | 44.26 | 0.0681 | 0.0200 | 38.76 | 0.0674 |
| | 2000 | 0.0346 | 58.37 | 0.0812 | 0.0273 | 49.76 | 0.0792 | 0.0185 | 43.26 | 0.0761 |
| | 2250 | 0.0318 | 64.53 | 0.0936 | 0.0252 | 54.92 | 0.0895 | 0.0168 | 47.53 | 0.0843 |
| | 2500 | 0.0290 | 70.04 | 0.1047 | 0.0231 | 59.79 | 0.0990 | 0.0151 | 51.57 | 0.0920 |
| | 2750 | 0.0263 | 74.83 | 0.1145 | 0.0208 | 64.02 | 0.1076 | 0.0133 | 55.34 | 0.0992 |
| | 3000 | 0.0236 | 78.92 | 0.1230 | 0.0187 | 67.87 | 0.1153 | 0.0114 | 58.83 | 0.1057 |
| | 3250 | 0.0211 | 82.44 | 0.1303 | 0.0164 | 71.29 | 0.1221 | ..... | 62.03 | 0.1117 |
| | 3500 | 0.0187 | 85.53 | 0.1368 | 0.0143 | 74.29 | 0.1281 | ..... | 64.92 | 0.1170 |
| 190 | 0 | 0.0409 | 2.83 | -0.0326 | 0.0353 | 2.76 | -0.0165 | 0.0237 | 2.69 | 0.0029 |
| | 250 | 0.0400 | 8.52 | -0.0210 | 0.0342 | 8.18 | -0.0057 | 0.0233 | 7.39 | 0.0059 |
| | 500 | 0.0392 | 14.63 | -0.0089 | 0.0331 | 13.53 | 0.0049 | 0.0226 | 12.29 | 0.0152 |
| | 750 | 0.0383 | 20.77 | 0.0094 | 0.0319 | 18.94 | 0.0156 | 0.0216 | 17.24 | 0.0244 |
| | 1000 | 0.0373 | 27.15 | 0.0159 | 0.0305 | 24.38 | 0.0262 | 0.0204 | 22.06 | 0.0333 |
| | 1250 | 0.0359 | 33.62 | 0.0285 | 0.0287 | 29.78 | 0.0366 | 0.0191 | 26.71 | 0.0419 |
| | 1500 | 0.3042 | 40.04 | 0.0409 | 0.0270 | 35.07 | 0.0467 | 0.0177 | 31.17 | 0.0500 |
| | 1750 | 0.0323 | 46.32 | 0.0529 | 0.0255 | 40.18 | 0.0565 | 0.0163 | 35.44 | 0.0588 |
| | 2000 | 0.0299 | 52.30 | 0.0643 | 0.0233 | 45.06 | 0.0657 | 0.0148 | 39.57 | 0.0653 |
| | 2250 | 0.0275 | 57.88 | 0.0756 | 0.0214 | 49.66 | 0.0741 | 0.0133 | 43.52 | 0.0724 |
| | 2500 | 0.0251 | 62.99 | 0.0883 | 0.0195 | 54.00 | 0.0823 | 0.0118 | 47.29 | 0.0790 |
| | 2750 | 0.0288 | 67.61 | 0.0935 | 0.0177 | 58.02 | 0.0898 | 0.0102 | 50.84 | 0.0853 |
| | 3000 | 0.0206 | 71.75 | 0.1015 | 0.0157 | 61.73 | 0.0967 | 0.0085 | 54.13 | 0.0910 |
| | 3250 | 0.0185 | 75.45 | 0.1085 | 0.0120 | 65.08 | 0.1029 | ..... | 57.13 | 0.0962 |
| | 3500 | 0.0164 | 78.73 | 0.1148 | 0.0103 | 68.09 | 0.1084 | ..... | 59.86 | 0.1008 |
| 220 | 0 | 0.0370 | 2.39 | -0.0315 | 0.0322 | 2.37 | -0.0153 | 0.0201 | 2.35 | -0.0016 |
| | 250 | 0.0360 | 7.52 | -0.0215 | 0.0310 | 7.15 | -0.0061 | 0.0198 | 6.61 | 0.0060 |
| | 500 | 0.0350 | 12.88 | -0.0175 | 0.0296 | 12.04 | 0.0031 | 0.0191 | 11.10 | 0.0139 |
| | 750 | 0.0340 | 18.36 | -0.0008 | 0.0281 | 16.96 | 0.0123 | 0.0181 | 15.60 | 0.0210 |
| | 1000 | 0.0328 | 23.94 | 0.0097 | 0.0267 | 21.89 | 0.0214 | 0.0170 | 19.98 | 0.0295 |
| | 1250 | 0.0315 | 29.55 | 0.0213 | 0.0251 | 26.77 | 0.0304 | 0.0158 | 24.90 | 0.0368 |
| | 1500 | 0.0298 | 35.11 | 0.0304 | 0.0233 | 31.57 | 0.0391 | 0.0145 | 28.23 | 0.0438 |
| | 1750 | 0.0279 | 40.58 | 0.0404 | 0.0216 | 36.23 | 0.0475 | 0.0131 | 32.11 | 0.0504 |
| | 2000 | 0.0258 | 45.85 | 0.0500 | 0.0199 | 40.73 | 0.0555 | 0.0117 | 35.86 | 0.0568 |
| | 2250 | 0.0236 | 50.87 | 0.0590 | 0.0181 | 45.03 | 0.0655 | 0.0103 | 39.44 | 0.0628 |
| | 2500 | 0.0215 | 55.59 | 0.0675 | 0.0166 | 49.10 | 0.0703 | 0.0089 | 42.84 | 0.0685 |
| | 2750 | 0.0195 | 59.99 | 0.0754 | 0.0147 | 53.01 | 0.0771 | 0.0074 | 46.06 | 0.0738 |
| | 3000 | 0.0176 | 64.09 | 0.0827 | 0.0130 | 56.57 | 0.0833 | 0.0059 | 49.06 | 0.0786 |
| | 3250 | 0.0157 | 67.87 | 0.0894 | 0.0113 | 59.86 | 0.0889 | ..... | 51.82 | 0.0830 |
| | 3500 | 0.0140 | 71.35 | 0.0955 | 0.0097 | 62.86 | 0.0941 | ..... | 54.34 | 0.0870 |
| 250 | 0 | 0.0339 | 1.51 | -0.0300 | 0.0295 | 1.56 | -0.0136 | 0.0170 | 1.60 | 0.0003 |
| | 250 | 0.0328 | 6.23 | -0.0212 | 0.0280 | 5.89 | -0.0056 | 0.0166 | 5.48 | 0.0069 |
| | 500 | 0.0318 | 11.05 | -0.0122 | 0.0265 | 10.31 | 0.0081 | 0.0160 | 9.54 | 0.0136 |
| | 750 | 0.0307 | 15.95 | -0.0033 | 0.0250 | 14.82 | 0.0104 | 0.0150 | 13.62 | 0.0204 |
| | 1000 | 0.0293 | 20.87 | 0.0056 | 0.0234 | 19.35 | 0.0184 | 0.0140 | 17.59 | 0.0269 |
| | 1250 | 0.0279 | 25.75 | 0.0143 | 0.0218 | 23.87 | 0.0262 | 0.0127 | 21.41 | 0.0332 |
| | 1500 | 0.0261 | 30.59 | 0.0229 | 0.0201 | 28.34 | 0.0339 | 0.0114 | 25.06 | 0.0388 |
| | 1750 | 0.0243 | 35.41 | 0.0313 | 0.0184 | 32.70 | 0.0413 | 0.0101 | 28.62 | 0.0448 |
| | 2000 | 0.0222 | 40.13 | 0.0395 | 0.0167 | 36.96 | 0.0484 | 0.0087 | 32.02 | 0.0502 |
| | 2250 | 0.0202 | 44.71 | 0.0473 | 0.0150 | 41.07 | 0.0552 | 0.0074 | 35.28 | 0.0554 |
| | 2500 | 0.0182 | 49.13 | 0.0548 | 0.0135 | 44.99 | 0.0617 | 0.0061 | 38.37 | 0.0602 |
| | 2750 | 0.0163 | 53.36 | 0.0619 | 0.0119 | 48.69 | 0.0677 | 0.0047 | 41.03 | 0.0642 |
| | 3000 | 0.0145 | 57.39 | 0.0686 | 0.0104 | 52.16 | 0.0733 | 0.0034 | 43.97 | 0.0687 |
| | 3250 | 0.0128 | 61.20 | 0.0748 | 0.0089 | 55.40 | 0.0785 | ..... | 46.45 | 0.0723 |
| | 3500 | 0.0112 | 64.79 | 0.0807 | 0.0075 | 58.38 | 0.0833 | ..... | 48.73 | 0.0756 |

The symbols and units used in this table are the same as those indicated in the nomenclature.

TABLE II. COMPRESSOR PERFORMANCE

| | TEST A* | TEST B | TEST C |
|---|---|---|---|
| Inlet temperature, °F. | 75 | 75 | 78 |
| Inlet pressure, pounds per square inch absolute | 40.7 | 63.7 | 79.2 |
| Discharge pressure, pounds per square inch absolute | 164.2 | 165.7 | 164.7 |
| Speed, r.p.m. | 200 | 200 | 200 |
| Compressor throughput, pounds per minute | 21.52 | 43.15 | 116.16 |
| Energy rejected to jacket, B.t.u. per pound of throughput** | 18.9 | 7.1 | 1.8 |
| Outlet gas temperature, °F. | | | |
| Measured at exhaust valve | 222 | 191 | 168 |
| Calculated for end of isentropic, adiabatic compression | | | |
| Perfect gas | 278 | 207 | 176 |
| Methane-Ethane Mixture | 250 | 194 | 170 |
| Calculated for compressor outlet (Equation 15) | 215 | 180 | 165 |
| Work of compression, B.t.u. per pound of throughput | | | |
| Measured by indicator card | 92.2 | 62.8 | 44.8 |
| Calculated from Equation 5 | 91.1 | 60.4 | 44.1 |
| Calculated for isentropic, adiabatic compression | | | |
| Perfect gas | 94.9 | 61.8 | 45.7 |
| Methane-Ethane mixture | 92.6 | 61.0 | 46.6 |

*—Tests A and B were made using only the head end of the cylinder while Test C involved both the head end and crank ends.

**—This was evaluated from the quantity of cooling water and change in its temperature. It neglects radiation and other energy transfers from the compressor.

adiabatic compression of the suitable methane-ethane mixture. In addition, corresponding values for this type of compression predicted on the basis of the perfect gas laws, using values of the ratio of the isobaric and isochoric heat capacities of methane as computed by Edmister have been included. A comparison of these values with the temperatures existing at the outlet valve as recorded in Table II indicates that reasonable agreement with the measured value is obtained when the heat rejected to the jacket was taken into account. The values obtained for adiabatic compression of the methane-ethane mixture agreed fairly well with the measured temperatures at low compression ratios but deviated sufficiently from actuality at the higher ratios to be of little

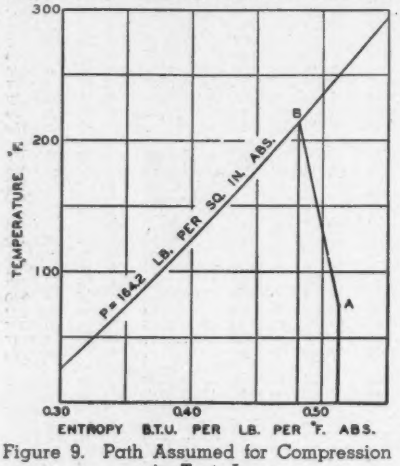


Figure 9. Path Assumed for Compression in Test A

engineering value. The maximum temperatures obtained on the basis of the perfect gas laws were much higher than the other values.

**Energy Requirements:** Since the states of the fluid entering and leaving the compressor have been established, the work required may be evaluated from Equation 5 and has been recorded in Table II along with the indicated work determined from the area of the indicator cards. The work of adiabatic, isentropic compression calculated on the basis of the perfect gas law using values of the ratio of the isobaric to isochoric heat capacities reported for methane by Edmister has been recorded in Table II. In the case of this dry gas at low pressures the agreement between the values is satisfactory but at higher pressures the work evaluated on the basis of the perfect gas law would not be expected to agree with the measured values as well.

## SUMMARY

The foregoing discussion of the application of thermodynamic data to the evaluation of compressor performance has indicated that certain experimental information concerning the behavior of a particular compressor is necessary or must be assumed in order to estimate the performance. For example, if the fluid friction and energy rejected to the jacket can be correlated as a function of the average gas temperature, the rate of compression and possibly the viscosity of the gas, the performance of the compressor may then be estimated for any other fluid for which suitable thermodynamic data are available. The information so obtained will include the work of compression and the outlet gas temperature. If indicator cards are available for the machine operating on the fluid in question the maximum gas temperature may be predicted with accuracy and the indicated work compared with that obtained from the state of the entrance and exit gases. The primary difference between these methods and those more often employed is their applicability to fluids which deviate materially from the perfect gas laws. Therefore, it would be expected that they would find more possible utility in connection with operations at relatively high pressures and with gases containing appreciable quantities of material of relatively high molecular weight. It is believed that the method is fundamentally sound and does not involve any assumptions other than those mentioned and digressions from actuality are probably due to the inadequacy of the experimental values at present available to describe the thermodynamic properties of naturally occurring hydrocarbon gases.

## ACKNOWLEDGMENT

This work was done as a part of the activities of Research Project 37 of the American Petroleum Institute to whom the authors are indebted for financial assistance. Compressor performance data were obtained through the kindness of L. F. Scheel from the work of the Gas Engine and Compressor Committee of the California Natural Gasoline Association. The assistance of R. A. Budenholzer in connection with the thermodynamic estimation of compressor performance is acknowledged. L. Fay Prescott and Louise M. Reaney carried out the extensive numerical calculations associated with the preparation of Table I.

### Nomenclature

- $a$ Cross-sectional area of flowing stream, square feet.
- $b$ Specific gas constant (R/M).
- $E$ Internal energy B.t.u. per pound.
- $F$ Fluid friction, B.t.u. per pound.
- $g$ Normal acceleration due to gravity, feet per second per second.
- $h$ Elevation above datum, feet
- $H$ Enthalpy, B.t.u. per pound.
- $\underline{H}$ Residual enthalpy, B.t.u. per pound.
- $k$ Numerical constant.
- $m$ Weight of gas, pounds.
- $v_m$ Volume of gas at standard conditions (60°F., 14.73 pounds per square inch absolute) corresponding to weight m.
- $M$ Molal weight, pounds.
- $n_1$ Weight fraction of component 1.
- $P$ Pressure, pounds per square inch abs.
- $Q$ Heat, associated with a process, B.t.u. per pound.
- $R$ Universal gas constant.
- $S$ Entropy, B.t.u. per pound/°F. abs.
- $\underline{S}$ Residual entropy, B.t.u. per pound/°F. abs.
- $s$ Time, seconds.
- $t$ Temperature, °F.
- $T$ Temperature, °F abs.
- $u$ Average velocity, feet per second.
- $V$ Specific volume, cubic feet per pound.
- $\underline{V}$ Residual volume, cubic feet per pound.
- $\mathbf{V}$ Total volume of system, cubic feet.
- $W$ Work associated with a process, B.t.u. per pound.
- $Z$ Compressibility factor ($Z=PV/bT$).
- $Z_0$ Compressibility factor at standard conditions (60°F., 14.73 pounds per square inch abs.).
- $\int$ Line integral.
- $d$ Total differential.

Subscript

A,B,.... Refers to states A,B,....

1,2,.... Refers to components 1,2,....

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## Production Practice Group Appointments For 1939

D. L. Caldwell, of Barnsdall Oil Co., Los Angeles, Calif., has been appointed national chairman for 1939 of the Topical Committee on Drilling and Production Practice of the American Petroleum In-

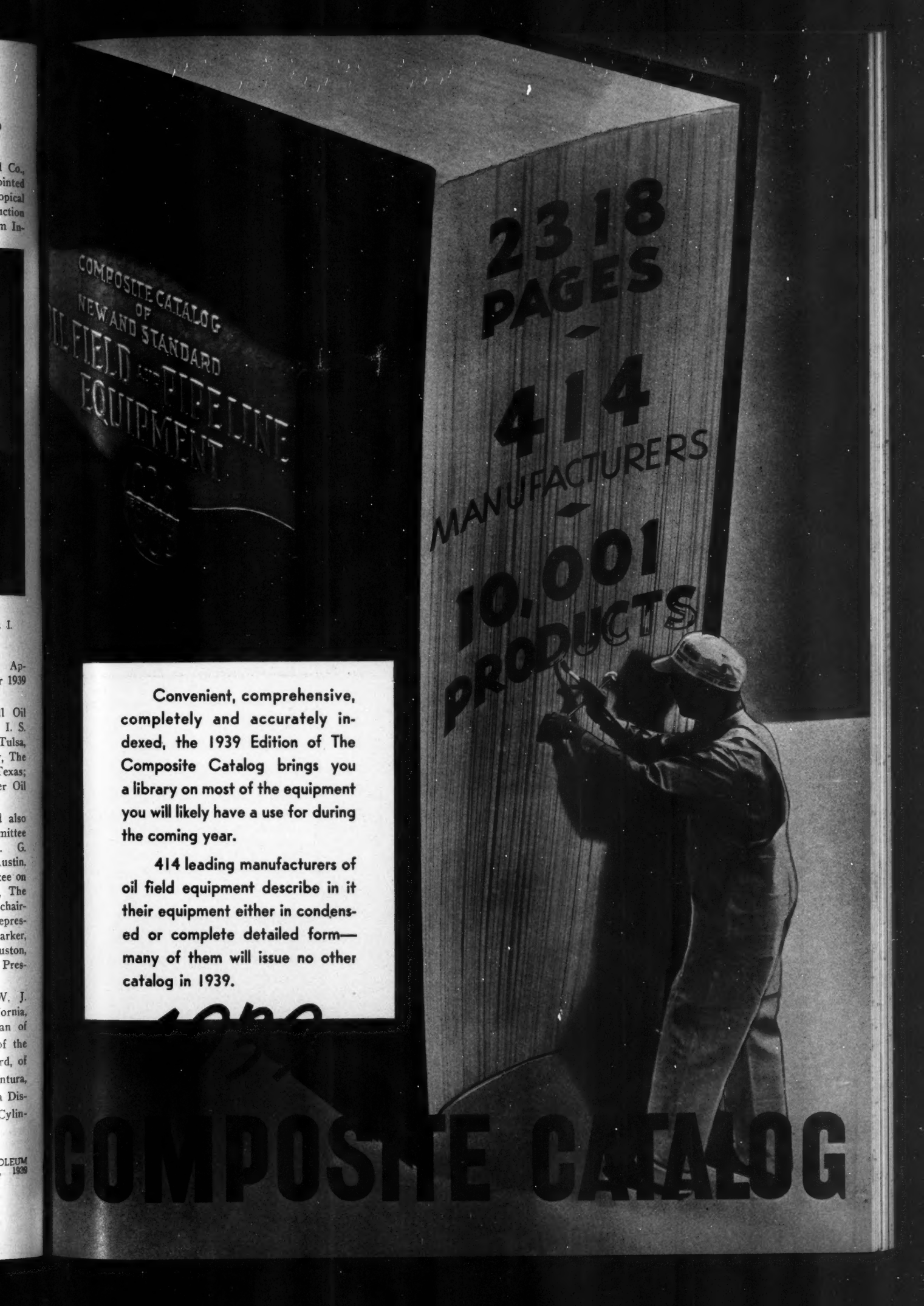
L. L. Aubert
Chairman of Pacific Coast A. P. I. Advisory Committee.

stitute's Division of Production. Appointments of district chairmen for 1939 have been made as follows:

California, Paul E. Lehr, Shell Oil Co., Los Angeles; Mid-Continent, I. S. Salnikov, The Carter Oil Co., Tulsa, Okla.; Southwestern, P. D. Torrey, The Sloan & Zook Co., Houston, Texas; Eastern, R. J. Sullivan, The Carter Oil Co., Mattoon, Ill.

Mr. Torrey has been appointed also chairman of the Special Sub-Committee on Secondary Recovery Methods. G. H. Fancher, University of Texas, Austin, Texas, is chairman of the Committee on Water Flooding. M. A. Wright, The Carter Oil Co., Seminole, Okla., is chairman of the Committee on Gas Repressuring. B. B. Boatright, of Parker, Foran, Knode, and Boatright, Houston, is chairman of the Committee on Pressure Maintenance.

Other appointments include W. J. Larson, Union Oil Co. of California, Bakersfield, Calif., as vice-chairman of the San Joaquin Valley Section of the California District, and C. H. Ward, of Tide Water Associated Oil Co., Ventura, Calif., as chairman of the California District Sub-Committee on Multiple Cylinder Gas Engine Maintenance.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COMPOSITE CATALOG

# L A U G H  T H I S  O F F

We were greatly surprised and just a trifle proud to read in a Mid-Continent petroleum daily recently an article headed, "Oil Man Wins National Egg Laying Contest."

---

And **Al Brown** swears he has lived in Coalinga for over twenty years, day in and night out.

---

Al is the industry's premier authority on poker, and believes it is the oldest card game in existence, in proof of which he offers the fact that Noah held a full house, and Solomon had a flock of queens.

---

Now we have a report from **Ted Sutter** to the effect that two local oil men who held the controlling interest in a dry hole, rode silently side by side in an auto away from the scene of disaster. They looked definitely worried, but neither spoke a word for a long time. Finally one heaved a deep sigh, and the other studied him for a moment, and remarked disgustedly, "You're telling me."

---

And says the disconsolate rousty, "I don't see why they fired me. I didn't do a thing."

---

One of these foggy mornings not so long ago, according to **Doc Emmons**, an oil chemist known to most of us called up his chief and delivered himself of this oration, "Say, boss, I'm sorry I can't come to work this morning on account of the fog. In fact, I haven't arrived home last night yet."

---

**Chas. Brown** says a group of lads were talking about wrestling the other day back in the dog house, and one told this exciting tale of his prowess. It seems that he was held up one dark night, and as he explained it, "This guy sticks a gun in my ribs, so I grabs him quick by the wrist, twists it up around his neck, and the first thing he knows, I'm lying on my back."

---

It was at this same meeting that **Bill Sievers** overheard a conversation between two buddies in the Biltmore. Says the first, "Lend me a nickel. I want to phone a friend of mine." Says the second, "Here's a dime. Call up all your friends."

---

And when the rousty asked the boarding house madam, "Who occupied this room last?" she answered, "Oh, a fellow I threw out when he owed six months rent." "Good," says the rousty, "I'll take it on the same terms."

---

You know, of course, that many a happy home has been broken up by an idle roomer.

---

**Ray Humphreys** now tells of an erudite oil man who asked a fellow employee, "What was the denomination of that bill I borrowed from you, Joe?" "Episcopalian, I guess," was the reply. "It certainly keeps Lent."

---

And we hardly think it would be wise to disclose the name of the fond father who said his youngster was so dirty when he came home they sand blasted him.

---

More or less substantiating the old definition of a boy as a "noise with dirt on it."

---

**Chief Major** writes in at this stage to express the belief that business is definitely improving, and in support of his contention points out that the Valley chiropractors are all receiving back pay.

---

And when the pastor said to the pumper, "I was sure pleased to see you at the prayer meeting on Wednesday night, John," the latter answered in evident relief, "Oh, so that's where I was."

---

Which recalls the Santa Fe Springs gauger who was being initiated into the Masons. He was as nervous as a kitten, and somebody tried to impress him with the fact that it was nothing to worry about. "Oh, no?" he snorted, "And I sold my old car to the Grand Master just last week."

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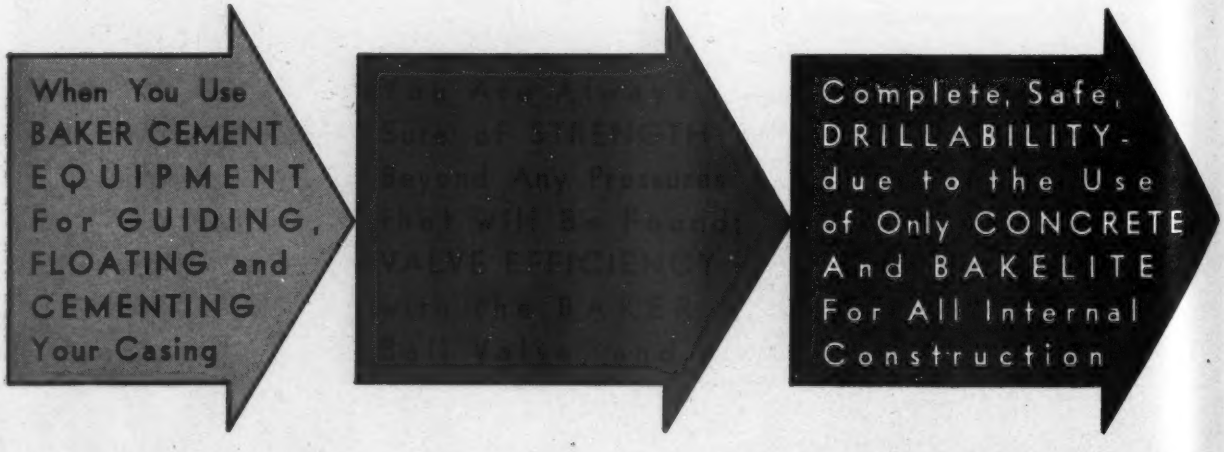
Wherewith we rush off in all directions, reminding you as we go of **Hubert Ferry's** oft-repeated contention that many a lease has expired long before it was executed.

## Doyle to Waukesha Pacific Coast Branch

Frank W. Doyle, member of the Waukesha Motor Co. sales staff for the past three years has been appointed to the West Coast branch where he will take up activities immediately.

Mr. Doyle will represent both the engine and refrigeration divisions of the company. He will function as assistant

Frank W. Doyle

to Mr. Wirshing in promoting sales of Waukesha Engines and Power Units and will also supervise the service program of the Refrigeration Division and the various products it manufactures for the railway and bus industries.

Previous to his new position, Mr. Doyle has served Waukesha in a number of capacities. Not only has he received a thorough groundwork in the production branch but, also he has had considerable experience as a member of Waukesha's widely known Research Department. Thus, he combines both a theoretical and a practical background with his sales training which has acquainted him with the application of Waukesha products to users' needs.

A native of Washington, D. C., Mr. Doyle received his early schooling there and graduated from the Electrical Engineering College of Purdue University. At Purdue he distinguished himself scholastically being elected to Tau Beta Pi, honorary engineering fraternity. Presently, his most vigorous outside interest is as an officer in the Field Artillery Reserve Corps of the U. S. Army. This activity he will continue on the West Coast.

## Eagle Oil & Refining In Building Program

One of California's independent oil refining companies has been increasing sales so rapidly during the past year that it has suffered from growing pains. With sales jumping ahead of production facilities the Eagle Oil & Refining Co., Inc., of Santa Fe Springs has just signed a license agreement with Universal Oil Products Co., and Universal engineers are making a complete survey of the plant and will make recommendations on changes and new equipment needed to insure maximum effectiveness in the over all operations of the refinery.

According to Harvey F. Nelson, president of the Eagle Oil & Refining Co., Inc., "We have shown 136% increase in sales in the last year jumping from 736,560 gallons in January, 1938, to 1,742,097 gallons January, 1939. While we have steadily increased the quality of Eagle gasoline so that we have a very small residue of gum, resin and impurities, we are determined to make our gasoline even better. We built facilities recently to permit us to enter the quality gasoline field and we are now manufacturing three grades of gasoline. An extensive advertising and sales drive has just been begun to establish the brand names of Eagle, Golden Eagle, and Panther gasolines. We have pledged to the trade and to the public a standard of quality which we must live up to and therefore feel the need for improvement in our manufacturing processes.

"We have retained Universal Oil Products Co. because we feel that their experience in installing Dubbs cracking plants in some of the country's largest refineries is of extreme value and we want to benefit by the experience of others. A survey is being made to see how the best features of our present Santa Fe Springs plant can be utilized and combined with the new units and equipment that will be necessary to increase efficiency and capacity. At present our plant has a proved charging capacity of about 3,000 barrels a day.

"Universal's engineering staff now has a number of representatives on the grounds and the surveys and recommendations are being rushed to completions as we wish to increase capacity as soon as possible."

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Fuel costs are cut to a minimum through the use of a gasoline blowtorch for heating in a new spray gun for lead-tin alloys.

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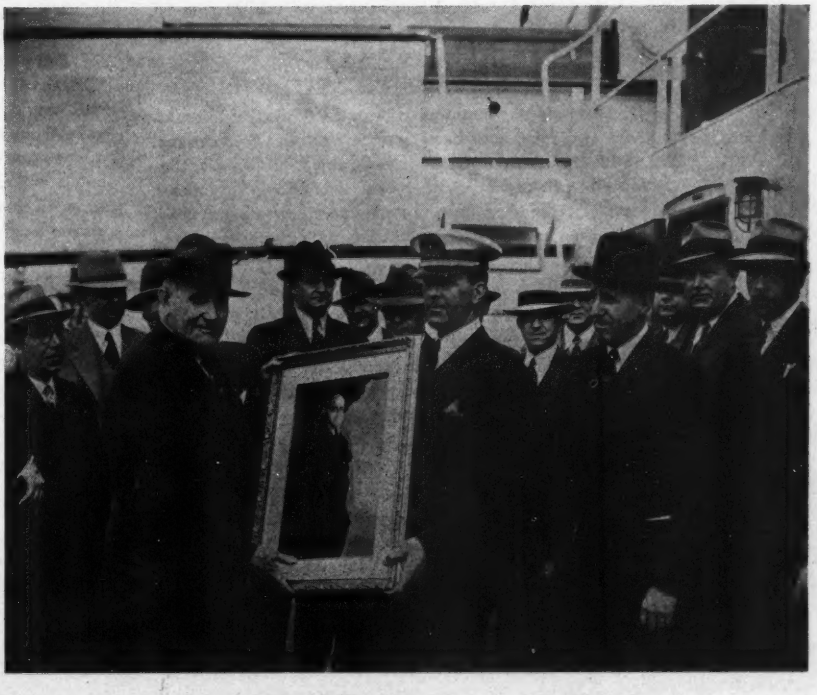
You are reading the Pacific Coast oil men's home paper.



Presentation of picture of L. P. St. Clair, chairman of the board of directors of Union Oil Company, by Mr. St. Clair to Captain Hans Halverson. Reading left to right: A. B. Mason, Asst. Comptroller, E. H. Estill, Asst. Secretary, M. W. Orcutt, L. P. St. Clair, Wm. Groundwater, Mgr. Marine Transportation, A. O. Pegg, Supt. Marine Engineering, A. C. Rubel, Mgr. Production, Capt. Hans Halverson, W. R. Edwards, Secretary, M. G. Kerr, Comptroller, P. M. Gregg, Vice-president and Counsel, H. E. Cattermole, Ship Dispatcher, A. S. Gunn, Gen. Mgr. (Pac. Coast) shipbuilding division Bethlehem Steel Company, Thos. B. Forester, Wilmington Supt. shipbuilding division, Bethlehem Steel Co.

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# PRODUCTION :-: DEVELOPMENT

(Figures of Production and Stocks are in barrels of 42 Gals.)

| Group No. 1 | Total Production February | —DAILY AVERAGE— Feb., 1939 | Jan., 1939 | Feb., 1938 |
|---|---|---|---|---|
| Arvin | 2,711 | 97 | ..... | ..... |
| Belridge—North | 343,201 | 12,257 | 12,546 | 15,123 |
| Belridge—South | 32,796 | 1,171 | 1,114 | 1,618 |
| Canal | 114,277 | 4,081 | 3,931 | 1,310 |
| Canfield Ranch | 682 | 24 | 32 | 124 |
| Coalinga | 273,481 | 9,767 | 9,656 | 11,148 |
| Cole's Levee | 5,027 | 180 | 171 | ..... |
| Edison | 68,289 | 2,439 | 2,509 | 3,708 |
| Elk Hills | 284,901 | 10,175 | 10,087 | 11,048 |
| Fruitvale | 204,534 | 7,305 | 7,087 | 9,310 |
| Greeley | 58,509 | 2,090 | 2,080 | 3,676 |
| Kern River | 306,276 | 10,938 | 11,246 | 14,719 |
| Kettleman Middle Dome | 1,104 | 40 | 37 | 80 |
| Kettleman North Dome | 1,619,227 | 57,830 | 58,383 | 80,416 |
| Lost Hills | 93,028 | 3,323 | 3,238 | 3,696 |
| McKittrick | 105,328 | 3,762 | 3,702 | 4,318 |
| Midway-Sunset | 1,567,399 | 55,978 | 55,665 | 74,394 |
| Mountain View | 258,817 | 9,243 | 8,795 | 13,512 |
| Mount Poso | 385,686 | 13,775 | 13,524 | 20,463 |
| Rio Bravo | 216,153 | 7,720 | 7,886 | 1,672 |
| Round Mountain | 349,581 | 12,485 | 12,109 | 17,340 |
| Ten Section | 250,745 | 8,955 | 8,743 | 4,578 |
| Tupman | 7,704 | 275 | 304 | ..... |
| Wasco | 19,496 | 696 | 702 | ..... |
| Wheeler Ridge | 11,179 | 399 | 381 | 313 |
| **Group No. 2** | | | | |
| Capitan | 76,203 | 2,721 | 2,740 | 3,022 |
| Elwood | 132,116 | 4,718 | 4,642 | 7,697 |
| Rincon | 102,666 | 3,667 | 3,846 | 3,604 |
| San Miguelito | 63,972 | 2,285 | 2,482 | 4,157 |
| Santa Barbara | 10,669 | 381 | 342 | 502 |
| Santa Maria | 417,461 | 14,909 | 16,613 | 15,608 |
| Summerland | 952 | 34 | 20 | 32 |
| Ventura Avenue | 959,633 | 34,273 | 33,678 | 36,989 |
| Ventura-Newhall | 156,093 | 5,575 | 5,516 | 5,537 |
| Watsonville | 840 | 30 | 30 | 50 |
| **Group No. 3** | | | | |
| Brea-Olinda | 157,142 | 5,612 | 5,600 | 6,269 |
| Coyote—East | 72,228 | 2,580 | 2,584 | 3,990 |
| Coyote—West | 223,585 | 7,985 | 7,915 | 8,095 |
| Dominguez | 595,245 | 21,259 | 21,715 | 29,322 |
| El Segundo | 105,180 | 3,757 | 4,003 | 16,711 |
| Huntington Beach | 779,655 | 27,845 | 27,475 | 34,759 |
| Inglewood | 355,368 | 12,692 | 12,933 | 16,016 |
| Lawndale | 1,990 | 71 | 62 | 90 |
| Long Beach | 1,391,985 | 49,714 | 49,220 | 57,550 |
| Los Angeles-Salt Lake | 15,456 | 552 | 497 | 546 |
| Montebello | 386,158 | 13,792 | 14,564 | 8,531 |
| Playa Del Rey | 150,083 | 5,360 | 5,347 | 7,172 |
| Potrero | 29,790 | 1,064 | 928 | 397 |
| Richfield | 228,447 | 8,155 | 8,131 | 9,942 |
| Rosecrans | 443,950 | 15,855 | 14,990 | 6,362 |
| Santa Fe Springs | 806,734 | 28,812 | 29,752 | 40,583 |
| Seal Beach | 213,860 | 7,638 | 7,633 | 9,794 |
| Torrance | 595,231 | 21,259 | 19,695 | 8,013 |
| Whittier | 27,602 | 986 | 988 | 922 |
| Wilmington | 2,338,527 | 83,519 | 83,875 | 101,163 |
| Total | 17,418,952 | 622,105 | 621,744 | 735,991 |
| January | 19,274,079 | 621,744 | | |
| Increase (*Decrease) | 1,855,127* | 361 | | |

| Group No. 1 | New Rigs Up | Active Drilling | Producers Completed | Daily Initial Output | Active Producing | Abandoned Wells Drillers | Abandoned Wells Producers |
|---|---|---|---|---|---|---|---|
| **Group No. 1** | | | | | | | |
| Arvin | .. | .... | 1 | 2,875 | 1 | .... | .... |
| Belridge—North | .. | 5 | 1 | 919 | 60 | .... | .... |
| Belridge—South | .. | .... | .... | .... | 87 | .... | .... |
| Canal | 2 | 1 | 2 | 2,192 | 19 | .... | .... |
| Canfield Ranch | .. | .... | .... | .... | 1 | .... | .... |
| Coalinga | 2 | 11 | 1 | 50 | 702 | .... | .... |
| Cole's Levee | 1 | 3 | .... | .... | 1 | .... | .... |
| Edison | .. | 1 | 2 | 125 | 88 | .... | .... |
| Elk Hills | .. | .... | .... | .... | 169 | .... | .... |
| Fruitvale | 2 | 1 | .... | .... | 173 | .... | 2 |
| Greeley | .. | 5 | .... | .... | 13 | .... | .... |
| Kern River | 3 | 4 | 2 | 11 | 1,340 | 1 | .... |
| Kettleman Middle Dome | .. | .... | .... | .... | 3 | .... | .... |
| Kettleman North Dome | 5 | 10 | 1 | 4,590 | 212 | .... | .... |
| Lost Hills | .. | 2 | .... | .... | 244 | .... | .... |
| McKittrick | 1 | 2 | 2 | 184 | 192 | .... | .... |
| Midway-Sunset | 2 | 5 | 1 | 40 | 2,524 | .... | 3 |
| Mountain View | .. | .... | .... | .... | 181 | .... | .... |
| Mount Poso | .. | 1 | .... | .... | 276 | .... | .... |
| Rio Bravo | 2 | 1 | 1 | 1,915 | 27 | .... | .... |
| Round Mountain | 4 | .... | .... | .... | 202 | .... | .... |
| Ten Section | 2 | 1 | 1 | 3,586 | 28 | .... | .... |
| Tupman | .. | 1 | .... | .... | 1 | .... | .... |
| Wasco | .. | 3 | .... | .... | 3 | .... | .... |
| Wheeler Ridge | .. | .... | .... | .... | 34 | .... | .... |
| **Group No. 2** | | | | | | | |
| Capitan | .. | 1 | .... | .... | 48 | .... | .... |
| Elwood | .. | .... | .... | .... | 80 | .... | .... |
| Rincon | 1 | 1 | 1 | 118 | 51 | .... | .... |
| San Miguelito | 1 | 1 | .... | .... | 19 | .... | .... |
| Santa Barbara | .. | .... | .... | .... | 35 | .... | .... |
| Santa Maria | 5 | 5 | 1 | 35 | 304 | .... | .... |
| Summerland | .. | 1 | .... | .... | 18 | .... | .... |
| Ventura Avenue | 3 | 10 | 1 | 1,160 | 267 | .... | .... |
| Ventura-Newhall | 3 | 7 | 1 | 150 | 549 | .... | .... |
| Watsonville | .. | .... | .... | .... | 7 | .... | .... |
| **Group No. 3** | | | | | | | |
| Brea-Olinda | .. | .... | 1 | 65 | 347 | .... | .... |
| Coyote—East | .. | .... | .... | .... | 86 | .... | .... |
| Coyote—West | 1 | 1 | .... | .... | 49 | .... | .... |
| Dominguez | 1 | 3 | .... | .... | 176 | .... | 1 |
| El Segundo | .. | .... | .... | .... | 51 | .... | .... |
| Huntington Beach | 3 | 4 | 3 | 1,100 | 549 | .... | .... |
| Inglewood | .. | .... | .... | .... | 209 | .... | .... |
| Lawndale | .. | .... | .... | .... | 6 | .... | .... |
| Long Beach | .. | .... | .... | .... | 1,258 | .... | 2 |
| Los Angeles-Salt Lake | .. | .... | .... | .... | 112 | .... | .... |
| Montebello | 5 | 13 | 6 | 6,132 | 225 | .... | .... |
| Playa Del Rey | .. | .... | .... | .... | 183 | .... | 2 |
| Potrero | .. | 1 | .... | .... | 14 | .... | .... |
| Richfield | .. | .... | 1 | 50 | 294 | .... | .... |
| Rosecrans | 2 | 5 | 2 | 1,472 | 122 | .... | 1 |
| Santa Fe Springs | .. | .... | .... | .... | 597 | .... | 1 |
| Seal Beach | .. | .... | 1 | 153 | 110 | .... | .... |
| Torrance | 19 | 16 | 17 | 9,182 | 698 | 1 | 2 |
| Whittier | .. | .... | .... | .... | 148 | .... | .... |
| Wilmington | 9 | 17 | 11 | 4,638 | 605 | .... | .... |
| Miscellaneous Drilling | 5 | 34 | .... | .... | .... | 6 | .... |
| **Group No. 4—Gas Fields** | | | | | | | |
| Buena Vista Lake | .. | .... | .... | .... | 5 | .... | .... |
| Buttonwillow | .. | .... | .... | .... | 26 | .... | .... |
| Chowchilla | .. | .... | .... | .... | .... | .... | .... |
| Delano | .. | 2 | 1 | .... | .... | .... | .... |
| Dudley Ridge | .. | .... | .... | .... | .... | .... | .... |
| Goleta | .. | .... | .... | .... | .... | .... | .... |
| McDonald Island | .. | .... | .... | .... | 6 | .... | .... |
| Rio Vista | .. | .... | .... | .... | 22 | .... | .... |
| Semi-Tropic | .. | .... | .... | .... | 14 | .... | .... |
| Tracy | .. | .... | .... | .... | 5 | .... | .... |
| February | 86 | 178 | 61 | 40,742 | 13,876 | 8 | 14 |
| January | 93 | 185 | 66 | 50,797 | 13,839 | 23 | 24 |
| Decrease (*Increase) | 7 | 7 | 5 | 10,055 | 37* | 15 | 10 |

**SUMMARY OF CALIFORNIA OILFIELD OPERATIONS FOR FEBRUARY, 1939—STOCKS HELD IN PACIFIC COAST TERRITORY BY CALIFORNIA OIL COMPANIES**

| | Feb. 28, 1939 | Jan. 31, 1939 | February Changes | Dec. 31, 1938 (Reclassified) |
|---|---|---|---|---|
| 1. Gasoline-Bearing Crude | 38,353,224 | 36,831,079 | +1,522,145 | 36,225,312 |
| 2. Non-Gasoline-Bearing Crude | 16,351,774 | 16,355,501 | − 3,727 | 16,282,177 |
| 3. Unblended Nat. Gaso. | 2,290,365 | 2,536,877 | − 246,512 | 2,699,455 |
| 4. Gasoline (not including distributing and service stations) | 15,040,909 | 14,265,941 | + 774,968 | 13,259,369 |
| 5. Naphtha Distillates | 1,566,651[1] | 1,669,331[1] | − 102,680 | 1,566,349[1] |
| 6. Gas Oil and Diesel Oil | 10,632,151 | 10,689,438 | − 57,287 | 10,539,937 |
| 7. Fuel Oil Residuum | 70,773,179 | 71,245,092 | − 471,913 | 70,957,881 |
| 8. All Other Stocks | 6,109,390[2] | 6,338,218[2] | − 228,828 | 6,153,809[2] |
| TOTAL | 161,117,643 | 159,931,477 | +1,186,166 | 157,684,289 |
| [1]Estimated amount of unfinished gasoline contained in item 5 | 1,333,333 | 1,408,777 | | 1,350,379 |
| [2]Coke included in item 8 | 156,248 | 124,576 | | 92,066 |

## Tide Water Associated Issues New Stamp Series

A new series of popular poster stamps, known as Associated Roads to Romance Stamps of the West, has been announced by Tide Water Associated Oil Co. Associated Division, according to P. E. Allan, domestic sales manager.

Available at all Smiling Associated Dealers in the west, the new series comprising one hundred subjects were released Mar. 27 together with attractive, heavily bound 48 page stamp books.

Following the unprecedented popularity of the 1938 series of Stamps of the West, Associated conducted a public poll resulting in the decision to issue a second series in 1939.

The first of this year's series is being released at all Smiling Associated Dealers in the west. The Golden Gate International Exposition comprises the subject matter for this initial stamp as well as the succeeding nine issues. These interesting Exposition stamps constitute the general subjects, being numbered from 101 to 110 inclusive.

The release of the localized stamps is scheduled in May, each local subject being available only in its immediate locale.

From May through November some localized stamp of other sections of the west will be available each week at every Associated Dealer's station. This will permit collectors to easily secure many of the stamps dealing with other locales. By visiting Associated Dealers in nearby communities, the collector can rapidly add to this list numerous local stamps not available in his immediate vicinity.

The entire series of those Roads to Romance stamps will be localized, with the exception of the ten general stamps dealing with the beauties to be found on Treasure Island at the Golden Gate International Exposition, which are available throughout the west, one each week, starting Mar. 27.

The new series of stamps are in sixteen colors, designed and drawn by a group of outstanding artists. Each is of two colors and depicts some noteworthy subject of interest to all collectors.

With a widely diversified range, the subjects of the hundred stamps will include, aside from the 1939 San Francisco World's Fair, Historic Trails of the West which cover the colorful Spanish Trails of the discovery era, the Oregon Trail made famous by the Lewis and Clark expedition, the Overland Trail and the Gold Trail.

The Early West, in which the independent actions and deeds of many types of men many miles apart and over a period of many years, wrote enduring pages in the history of the west, comprises an intriguing portion of the stamp subjects.

Seven of the localized stamps deal with the Western Wild Life, while an equal number cover the native Birds of the West. Under the title Flowers of the West, seven stamps combine the state flowers with background of the State Capitols of California, Oregon, Washington, Idaho, Nevada, Utah and Arizona.

Famous trees of the West, from the Douglas Fir of the Pacific Northwest to the Joshua Tree of the Southern California Desert country, are vividly portrayed in a series of eight stamp subjects.

Thirteen subjects depict the oddities of nature, such as are found along Western Roads to Romance. These are followed by a series on Man's Conquest of Nature, in which the great engineering projects, such as Shasta Dam, Lake Meade and the Government Locks in Seattle, are shown.

Every turning of a hundred highways threading the Western world from Canada to Mexico affords a fascinating series of stamps featuring scenic subjects in a Land of Contrasts. This group includes items such as the Peace Portal at Blaine on the Canadian boundary and Fisherman's Wharf in San Francisco.

Honolulu, Hilo and Manila stamp subjects complete the new series of these brilliant and interesting Western Roads to Romance Stamps of the West.

The Choice of subjects for the 1939 series of stamps, for the greater part, is the result of the recent public poll in which thousands of westerners and visitors made known their suggestions.

The free distribution of the stamps and the stamp books will mark another forward step in publicising the wonders and beauties of the great western empire, affording everyone an opportunity to secure a permanent historical collection produced in an attractive, conveniently compiled volume.

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**Automotive tax bill for the nation for 1938 will exceed by more than $200,000,000 the factory value of new cars and trucks sold in the United States during the year.**

MOTOR MEMOIRS
BY M. O'HARE '39
VIVA! GENERAL PANCHO VILLA'S ALL-STEEL WAR TRUCK HELPED HIM WIN MANY BATTLES DURING HIS CAMPAIGN AGAINST HUERTA
ONE-TWO-THREE UP
REMEMBER THE AMERICAN ONE-MAN MOHAIR TOP THAT WAS THE MARVEL OF THE EARLY 19-HUNDREDS? MOHAIR VELVET IS THE MARVEL TODAY. IT'S THE AUTOMOBILE UPHOLSTERY THAT HAS EVERYTHING---BEAUTY, COMFORT, DURABILITY, CLEANLINESS, AND GREATER TRADE-IN VALUE.
LITTLE MISS MUFFETT...
THIS 12-H.P. LIGHT BROOKE CAR OF 1902, WITH ITS "SPIDER" SEAT, WAS THE JAUNTY IDOL OF ALL YOUNG DANDIES OF ITS DAY.
THESE CARTOONS ARE THE ARTIST'S INTERPRETATIONS OF AUTO HISTORY COPR. 1939 BY CABELL-EAMES INC.

# Buying and Using Compensation Insurance

## Discussion of Factors to Weigh

By R. P. Nall*

"Can we cut the costs of our workmen's compensation insurance?"

Far too many representatives of compensation insurance companies confidently answer "yes" to that question—adding, however, the qualifying statement: "provided you insure with us!"

Thus they create the impression that lowering compensation costs is simply a matter of changing insurance companies and postpone the evil day when they, or their superiors, will have to say something like this:

"Your costs depend on so many things that no company can honestly guarantee to reduce them. They depend on the type of carrier you select and on whether or not it is committed to a policy of paying dividends to policyholders.

"They depend on the services your carrier offers and the uses you make of those services. They depend on your record of accident experience, on your safeguarding and on the carrier's administrative efficiency."

That is what a compensation insurance company's representative **should** say. For he knows that in the beginning all the employers in any classification must pay the same basic rate—a rate established by the California Insurance Commissioner in conjunction with the California Inspection Rating Bureau.

The representative also knows that to this basic rate your own experience rating forces the addition or permits the subtraction of an amount which reflects your individual experience record and the credits available to you for safeguarding, safety organization, etc.

Once the employer understands the multiplicity of factors which have a direct bearing on his insurance rates, he will find himself coming almost immediately to this conclusion:

**..That he should use more care in the original selection of an insurance company and that he should make better use of the services that company offers.**

When he has reached that conclusion he has taken the first, and one of the most important steps which will almost invariably lead to lower net compensation insurance costs.

Faced with the problem of comparing one insurance company with other companies, many an employer has thrown up his hands, feeling there is no basis of comparison of institutions who market a thing so intangible as service.

Actually, the reverse is true. The service of any company directly reflects the history, ability, policies and personnel of that company. The performance story of any company can be broken down into small parts which permit accurate and intelligent comparison. These parts are:

1—The history of the company and its record of growth; 2—The size and nature of the company's organization; 3—The scope of services it invariably offers to policyholders; 4—The individual ability of its personnel; 5—Its policyholders; 6—The result (in the way of lowered net compensation costs) it has helped policyholders to obtain; 7—Its methods and policies; 8—Its financial structure; 9—Its specialized knowledge of the problems of your industry.

"But," you may say, "why should I be interested in how fast a compensation insurance company grows; or the ability of its personnel; or its methods and policies?"

The answer is that in any one or all of these individual factors may be found the secret of the success of one compensation insurance company and the mediocre record of another. Consider just a few of the nine points previously mentioned and you will see the importance of considering all of them:

**History-Record of Growth:** Knowledge of the past of any company gives some hint as to its present and future. Has it a long and distinguished record or is it comparatively new? Has it always specialized in compensation insurance or is compensation a sideline? Has its growth been steady or has it remained practically stationary?

**Size and Nature of Organization:** Many interesting facts can be developed about the size and nature of the organization of a company. Is it a local company, so that dealings may be had with principals? Is service available throughout the State? What is its type of organization—stock company, mutual company or reciprocal?

**Scope of Service:** Does the company simply agree to pay accident losses when they occur, or does it seek to surround its policyholders with the **plus** or protective services which seek to prevent accidents?

**Results:** Since it is impossible for any company honestly to promise that it can effect a better experience rate for a policyholder, the results it has achieved for other policyholders with similar problems is an important yardstick in measuring the value and effectiveness of the services it offers you. Make certain that your questions as to results are not answered by meaningless statements such as "We made a wonderful record for the Blank Co" or "We did a fine job for one of your competitors." Ask to see facts and figures. Ask for an explanation of just what services were performed. Ask for names and for substantiating letters.

On each of the nine points previously mentioned it is possible to ask for and receive information that will take much of the mystery out of buying compensation insurance. And once such information is at hand the problem of determining which company is most likely to give you the help you need in reducing the net costs of your compensation insurance becomes surprisingly simple.

How can you make better use of the services a compensation insurance company offers? Some employers believe a carrier is performing all of its functions when it pays claims promptly and without "bothersome contacts." They do not realize the eventual cost—to themselves—of such a carefree attitude. For it is the painstaking attention to what may, at first, seem to be non-essential details which measures the ultimate value of the compensation company to its policyholders. It is the attention to such detail that definitely proves that compensation insurance can be made to **make** as well as **protect money.**

Admittedly, it is sometimes difficult to demonstrate the cost of an accident that has not happened. But if it is remembered that experts estimate that the indirect costs of any accident—the lost time, machinery breakage, necessity of training new workers, etc.—is at least four times the amount directly paid out in claims and medical expense, the importance of any service which will, in any measure, lessen the perils surrounding any operation should be apparent to every employer.

Suppose that we take it for granted that you have selected an insurance company which offers services designed to prevent accidents; which is anxious to do all within its power to help you achieve a lower net compensation cost—how can you best make use of the services offered?

To begin with, make it plain that you are seriously determined to make a saving in your compensation costs and are willing to do everything within your power to effect such a saving. Such a point of view instead of the old-fashioned "you have our insurance and from now on it's up to you" attitude will make a surprising difference in the insurance company's willingness to serve.

When the company's safety engineers make recommendations for safeguarding,

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* Manager Southern Division, Industrial Indemnity Exchange.

or for any improvement in operating methods, adopt as many of the recommendations as possible. If you used care in selecting the insurance company in the first place, you made sure that its engineers were men of practical experience in the oil industry. Their recommendations, based on solving problems similar to yours, should, therefore, be practical for you. If some recommendations are impossible to carry out at the outset, do not throw out the entire program. Discuss the program with the engineers and agree which steps are to be taken first and which are to be carried out at a later date.

Go over the entire program and arrive at a decision as to what co-operation the engineer needs to put it in force. In that way the insurance company knows what it must do and what you will do to help.

Establish a simple and understandable standard of practice for reporting accidents as they occur. Cooperate with claims men when they investigate accidents. On the facts developed by your reports and the claims men's investigations the effectiveness of steps to prevent recurrences may depend.

Ask for simple and understandable claims reports from the insurance company. Claims reserves set up should be reported to you as the accidents occur. Claims payments should be reported as they are made. When these reports come in, go over them with the insurance company's engineer and with your foreman and employees. In no other way will you keep abreast of what accidents are costing you. In no other way will hazards be revealed as effectively. And in no other way will your employees be so strongly impressed with the value of safety, the dangers of carelessness and the importance of the steps you are taking to safeguard their welfare.

Many important savings in compensation insurance premium payments are affected through closer cooperation between the policyholder and the insurance company's payroll auditing department. Before you undertake any new operation, ask the company for the classification and rates applicable to your operations in order that you may arrange for proper segregation of your payrolls as work is being done.

To summarize: Net cost of compensation insurance is, to a greater extent than the average employer realizes, a matter over which he has real control since it depends largely on the company insuring him, the type of services that company offers, and the use he makes of those services. If he chooses his insurance company wisely, demands complete services and makes full use of those services, he can usually bring about substantial reductions in the net cost of his compensation insurance.

IDECO Type R-3 Building. Combination Field Office and Warehouse at Canal Field in California.

## Ideco Steel Buildings Described in Bulletin SB-38

In the publication of Bulletin SB-38 it was the aim of International Derrick & Equipment Co. to furnish information which will be of value in the formulation of building plans. Attention is called to these outstanding quality features of IDECO Standard Steel Buildings.

**Quality feature No. 1 — Weather tightness.** Ideco Lock-joint Sheeting and double flashing throughout.

**Quality feature No. 2—Permanence.** Hot dip galvanized structural frame, trusses, sash, and hardware. Steel, iron or copper bearing galvanized sheeting.

**Quality feature No. 3—Attractiveness.** Good proportions, uniform ribbed sheeting, carefully designed trim.

**Quality feature No. 4—Ease of Erection.** Interchangeable sidewall panel construction and simplicity of design.

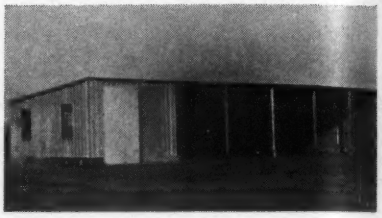
**Quality feature No. 5—Habitable.** Complete insulation against heat or cold.

Each of these Quality Features is described in detail and each one plays a very important part in the selection of a building to meet needs.

The fact that IDECO Standard Steel Buildings incorporate these exclusive features make them outstanding in the standard building field. No effort has been made to stint quality for price, but through standardization and modern industrial progress, production costs have been reduced and greater values are given to the buyer, the makers say.

The ready adaptability of standardized buildings to practically every form of industrial building requirement is a matter of record. Thousands are in use throughout the world by every branch of industry.

The success of IDECO Standard Buildings can be attributed to their fitness in meeting exact requirements for one or two story industrial buildings. Easily erected, they are strong, permanent, weather-tight structures, attractive in appearance. Their sectional form of construction makes them easy to dismantle and permits them to be transported and re-erected with full salvage value. Through the use of standardized parts and sectional panels, alteration is a simple matter, does not require the complete dismantling of the building, and is a tremendous advantage in planning for future expansion.



IDECO Type L-3 Building. Field Repair Shop and Automotive Equipment Shelter.

IDECO Buildings are made in a wide variety of roof styles and sizes. They can be erected singly or in innumerable combinations to meet any specific requirements.

A study of this illustrated booklet will reveal many interesting facts regarding the construction of IDECO Buildings.

All IDECO buildings are furnished complete above foundations, including foundation bolts and foundation bolt plan.

Customers find no difficulty in erecting these buildings. However, IDECO will arrange to furnish an erection superintendent if desired.

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Just 50 years have passed since the first recorded crude oil production in the Southwest—production of 48 barrels of oil from two wells near San Antonio, Texas, a quantity which is little more than enough to supply the annual petroleum needs of one American family today!

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Petroleum was called "American Oil" in doctor's prescriptions when first used as a medicine.

## Vernon Tool Co. Buys Western Engine Corp.

Vernon Tool Co., Ltd. announce the purchase of the business of the Western Engine Corp., pioneer local concern which has been actively engaged in the manufacture of heavy Gas, Gasoline and Diesel Engines and specialized mechanical equipment since 1887.

During these years, Western Engine Corp. played a large part in the development of reliable power for agriculture, pumping plants and marine and oil field power units, throughout the United States and in many foreign countries, over half a million Horse Power of heavy duty Diesel, Gas and Distillate Engines having been sold.

Western Engine Co., operating as a division of Vernon Tool Co., Ltd, will continue, without interruption, the Service, Repair and Parts business for engines now in operation and will manufacture a complete line of stationary and marine Diesel and natural gas engines.

Vernon Tool Co., Ltd. is a local concern, heretofore specializing in oil field products, and by adding the manufacture of engines to their activities, will greatly expand their operations.

Officers of the company include A. F. Morlan, president of the Title Guaranty and Trust Co., also president of Vernon Tool Co., Ltd., Ward Blackburn, vice-president and general manager, V. H. Bowen, treasurer, and John Suter, chief engineer.

## Accommodations Assured for Visitors at Houston Oil Show

To make sure that all visitors and exhibitors and their representatives are properly taken care of during the Oil-World Exposition at Houston, Tex., from Apr. 24 to 29, inclusive, a Housing Bureau has been established by the Convention Department of the Houston Chamber of Commerce. Many reservations made with the Exposition management have already been handled by this bureau and Ed. G. Lenzner, General Manager of the Oil-World Exposition advises that with the arrangement now made every convenience will be provided in spite of the large number of people to be housed.

The Housing Bureau is keeping in daily contact with all hotels in the city in order to maintain a continuous record of available rooms. A list of rooms in private houses is also being kept so that requests for these accommodations can be readily filled. In making reservations, the Exposition Management desires that all requests be made direct to T. A. Sieferth, Manager, Convention Department, Chamber of Commerce, Houston, Tex.

## Belyea Truck Co. Introduces New Services

The inauguration of a new heavy interstate transportation and erection service for California, Arizona, Nevada and New Mexico has just been announced by the Belyea Truck Co. of Los Angeles. The Belyea company has received authority from the Interstate Commerce Commission to operate the rights formerly operated by the Hutchinson Transportation Co., Inc., and they plan to extend this service to include the facilities of Pacific Crane & Rigging, Inc., a Belyea subsidiary.

This new service, featuring "Engineered Transportation" and backed by one of the largest and most modern fleets of trucks in the west, will give the local industrial centers of the new territory a heavy transportation service that is fast and economical. In conjunction with this transportation service, the Belyea Truck Co. will offer a new engineering construction service that will concentrate on erection and dismantling of heavy industrial and mining equipment, and on all types of excavations.

Behind this latter service will be Pacific Crane and Rigging, Inc. The facilities of this company are especially adapted for use in the new territory and such equipment as may be required for the moving of heavy industrial and mining machinery is available. The company also maintains a staff of well trained operators and superintendents, all of whom have had years of experience in this type of operation.

Other equipment of this organization is a fleet of modern, truck mounted cranes, pneumatic tired throughout and capable of being rapidly moved to any point in the territory on short notice. The cranes can be furnished with boom lengths up to 90 feet and can be equipped as Dragline, Dipper Stick, Clambshell or as Magnet Cranes.

The inauguration of this new service comes as a culmination of a survey conducted by the company's engineers. The survey revealed a great need for the heavy transportation service and more so for the engineering construction service. By placing the facilities of Pacific Crane & Rigging, Inc., in this territory it is believed that a great deal more progress can be made by the local industries.

One of the outstanding features of the new Belyea interstate transportation system will be the direct hauling between the California harbors and points within the states of Arizona, Nevada and New Mexico. With the Belyea Truck Co. operating office in San Diego and Oakland, as well as at Wilmington, through shipments will be handled with less loss motion and expense.

To handle local business, the Belyea Truck Co. plans to open several local offices throughout the new territory. In each of these local offices there will be a qualified engineer and an estimator. Behind these local offices will be the entire Belyea organization and 25 years of experience in Engineered Transportation.

## Victor Welding Catalogue

Victor Equipment Co., with headquarters at 844-50 Folsom St., Los Angeles, is now ready to release, through its national distributing organization, a new and comprehensively illustrated 32-page welding and cutting apparatus catalogue.

This particular catalogue combines the essential equipments covered in individual and previously issued catalogue sections.

Of particular interest to the reader are the numerous welding and cutting units. The catalogue has been carefully designed to simplify the purchase of Victor equipments, and it offers all essential facts necessary to guide the purchaser in a suitable selection from the very large variety of torches, regulators and accessories manufactured by this internationally known producer of welding apparatus.

## New Union Tanker Reaches Los Angeles

Completing her delivery voyage from the Sparrows Point, Md., shipbuilding yard of the Bethlehem Steel Corp. to her home port in 24 days, the new Union Oil tanker L. P. ST. CLAIR, arrived at Los Angeles harbor on Friday, Mar. 24. Occasioned by the arrival of the L. P. ST. CLAIR, eleventh and largest of the company's fleet of sea-going tankers, an inspection tour and buffet luncheon were held on board for Union Oil executives and directors. Among the executives present at the welcoming ceremony were: L. P. St. Clair, chairman of the board; Reese Taylor, president; W. L. Stewart, Jr., vice-president in charge of transportation; and vice-presidents, P. M. Gregg and A. C. Rubel.

As a part of the welcoming ceremonies, Mr. St. Clair presented Captain Hans Halverson with a framed photograph of himself to be hung in the Captain's stateroom. The presentation carried out a traditional custom of the sea, which requires the person having a ship named in his honor to present the captain with a picture of himself.

During the two days the ship was in port, more than 3,000 Union Oil employees and their friends came aboard. Docking in San Francisco on Monday, Mar. 27, the tanker was viewed by a large delegation of company employees residing in the Bay area. Returning to San Pedro, the L. P. ST. CLAIR will take on her first full cargo consigned to the Northwest.

With the arrival of the L. P. ST. CLAIR, old-timers recalled the first tanker built for the company in 1900, the SANTA PAULA, 4-masted schooner-rigged vessel, launched at Fairhaven, Calif. She was 183 feet in length and carried a cargo of 8,200 bbls., quite a contrast to the 463-foot L. P. ST. CLAIR having a storage capacity of 104,000 bbls.

Replete with every modern device for the safety and comfort of the crew, the large tanker has been constructed in accordance with the highest standards set by the Bureau of Marine Inspection and Navigation. Deck officers have individual quarters amidships, providing direct access to the bridge. The crew of 31 men have been provided with 16 comfortable rooms. A specially designed ventilating system provides 15 complete changes of air to all living quarters every hour, and a chilled drinking water system has been installed. In case of an emergency, the tanker has been equipped with a distillation apparatus which can produce fresh drinking water from the sea.

## The Value of a Packing Survey

By R. G. Roshong, Manager
Crane Packing Company's
Los Angeles Office

When you deal with equipment handling 1200 lbs. pressure, oil, and high speeds up to 3000 RPM. or more, and temperatures 750°F. and up, you want to "know your onions" if you are asked to make recommendations on this equipment.

Times have changed greatly since the days of Fulton and his old steamboat. A piece of rope or hemp, lubricated with tallow was the best packing they had those days. And good enough, engineers thought.

Even though very great developments in packing were made since Fulton's time, such as asbestos yarn packings, woven or braided, and graphite impregnated and lubricated packing, still the present-day high pressure, high temperature, high speed equipment requires and demands better packing materials and better lubrication.

Temperatures of 750°F. and up have forced engineers to consider and use for these most difficult packing services only the purest asbestos fibre, only the purest graphite, and the use of metal foils, such as copper, aluminum and monel. Research and actual operation further developed these combinations of material into the present well-known packing forms of dry-graphitized plastic, flexible all-metallic, semi-metallic, metal-jacketed packings, manufactured in convenient spirals, coils, reels and moulded die-formed rings and sets.

From the standpoint of safety in operation, elimination of shut-downs, prevention of fires, saving in power consumption by reduction in friction, and entire elimination of leakage losses, these packings have been recognized by the leading refinery and power plant engineers in this country and abroad as the safest and most economical packings to use and adopt.

For reciprocating or centrifugal slow speed, low temperature, light pressure pumps, the packing requirements are not so severe, and the use of babbitt or white metal foils are permitted and have been very successfully used. I refer to refinery services such as crude oil, gasoline, kerosene, butane and other forms of distillates.

On steam pumps or air compressors, whether high speed or slow speed, low pressure or high pressure, dry-graphitized plastic packing in combination with flexible metallic packings has given outstanding success. The steam and air rods become highly polished and the packing lasts for years. Power consumption is at the minimum.

This preview on the development of packings all leads us up to the present-day packing survey which is absolutely essential in safeguarding the plant against costly failures and shut-downs. At the time pumps, air compressors and other important equipment are selected and purchased, that is just the time to have a packing survey made and the pump packing specified or purchased which will meet the conditions of operation such as: (1) material to be pumped; (2) gravity; (3) pressure; (4) R.P.M.; (5) temperature; (6) metal of shaft, rod or plunger; (7) stuffing box dimensions; (8) style recommended.

This packing chart or survey constitutes a record for the operators which simplifies to the minimum the replacement of packing and the delivery to the proper pump for which it was ordered. This is a great help to the operators and mechanics for they know if they use the packing shown on the survey there will be no failure and the utmost service will be rendered. It has been thoroughly demonstrated in our contacts with the largest refinery work in this country and abroad, that a packing survey and proper recommendations based on actual service conditions is the only plan to follow if you expect successful and continuous uninterrupted performance when the plant is thrown on the load.

A packing survey by experienced packing engineers, and the installation of proven combinations of packing eliminate costly shutdowns, scored sleeves and rods, thereby lowering the cost of operation of your plant.

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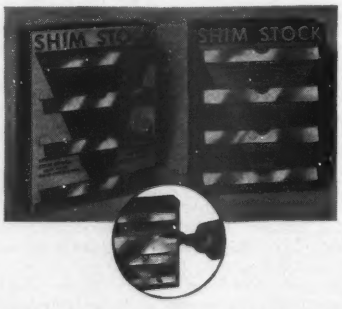
## New Shim Kit With .001 inch Stock

The popularity of Laminated Shim Co.'s new "Economy" Carton containing a handy assortment of the most frequently used thicknesses of thin brass shim stock, has resulted in a demand




The thin shim stock is simply pulled through slot in the "Economy" Carton—and cut off as needed.

for thin steel shim stock in a similarly convenient assortment and container.

Kit No. 88-S is therefore now made available. It consists of four 6x50-inch rolls of precision steel shim stock, in thickness of .001, .002, .003 and .005 inch; all packed in the new "Economy" Carton. This carton stands on self-easel, or may be hung on the wall. Shim stock, of any roll, is simply pulled through a slot in the carton and cut off as needed—thereby avoiding waste, wrinkling or damage in handling, and effecting considerable time-saving. **Note that .001-inch thick steel shim stock is now readily obtainable for the first time.**

Laminated Shim Co. announce also that their regular line of 6x100-inch brass or steel shim stock rolls, each packed in slotted carton, has been enlarged. Thicknesses of the brass shim stock in this size now range from .001 to .010-inch, and in addition .012 and .015 inch thicknesses. The .0015 inch and the more or less odd thicknesses of .004, .006, .007 and .009-inch thickness are also included. In steel, the thicknesses have been extended to include not only the .001 inch, but also a complete range through .010 inch, and .012 and .015 besides.

Further information on this complete line of **packaged** precision shim stock may be had from leading mill supply houses or from the general offices of the Laminated Shim Co., 21-44 44th Avenue, Long Island City, N. Y.

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## M. E. Canfield Co. Named By Laminated Shim Co.

Negotiations have been concluded between Laminated Shim Co., Inc., Long Island City, N. Y., and the M. E. Canfield Co., manufacturers' agents, 420 East Third Street, Los Angeles, Calif., whereby these agents will represent the New York manufacturers in the California territory south of the northern boundaries of San Luis Obispo, Kern and San Bernardino counties.

The West Coast agency headed by M. E. Canfield will be directly responsible for sales and servicing—in the general industrial and mill supply fields—of all Laminated Shim Co. products, including Laminum shims (which peel for precision adjustment) and babbitt-tipped shims. Laminum shim stock, plain shims and shim stock, arbor spacers, and metal stampings. The entire shim stock line handled through mill supply distributors is a packaged line, characterized both by a strictly precision quality of product and the convenient new "economy" dispensing and storage containers devised for its easy handling.

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A recently developed tool produces pressures up to 1,500,000 pounds per square inch, making it possible to study the structure of the earth 200 miles below the surface.

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Recent oil discoveries between the Ural Mountains and Western Siberia are being developed on a wider scale by the Soviet petroleum industry.

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You are reading the Pacific Coast oil men's home paper.

Seventy friends of A. M. Mulford and his son, R. A. Mulford, whose business associations with the Mulford Manufacturing Co. have extended through many years, attended the "get-together-dinner" given by the Mulfords April 12, at Carl's Banquet Room in Los Angeles.

## Mulford Celebrates 20th Anniversary

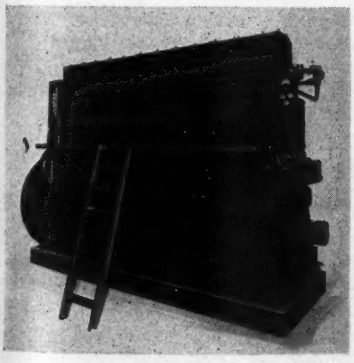
A. M. Mulford, head of the oil field and plant equipment manufacturing company, denoted the occasion as the twentieth anniversary celebration of manufacturing activity in Los Angeles. In his introduction of all the men present and their wives without pause in the proceeding, the elder Mulford evidenced a close personal association with those he has served as a manufacturer. The responses must have been highly gratifying to the father and son.

The path which was to lead the elder Mulford to his position as an important manufacturer started in the engineering department of the C. I. & L. Railroad. Just prior to his founding of the Mulford Manufacturing Co., he was associated with the Kimball Pump Co. The Mulford company serves numerous organizations, such as Natural Gas Equipment Co., in fabrication of equipment. In producing the Tuktap Tap, the Mulford company manufacturers the only tap made west of Detroit.

## Worthington All Enclosed Direct Injection Diesels

Worthington Pump and Machinery Corp. of Harrison, N. J., has issued new literature describing its new type CC totally enclosed, direct-injection Diesel engine. Of the four-cycle, trunk-piston type, using a direct fuel-injection system, the new engine is of the simplest and most compact design consistent with high efficiency and complete accessibility. All moving parts are wholly enclosed.

The cone-type cylinder head featured in the CC engine is a Worthington development which has eliminated the possibility of head breakage due to load and temperature stresses. Full provision for expansion is made in this construction, and the need for a gasket between the cylinder head and the liner is abolished.



The lubrication system of the engine has been developed to a degree not exceeded by any other oil engine. All moving parts are pressure-lubricated. The main bearings receive their supply of oil from a cast-in, jointless oil pipe in the base. Positive sight-feed lubrication of cylinder walls is also provided. Liberal oil storage is built into a deep sump in the base beneath the screens.

This engine has been developed for installation where continuous, heavy duty loads are to be carried. It is applicable to municipal and industrial plants, and is an ideal peak-load unit for larger plants having other types of prime movers. It is adaptable to pumps, compressors and other power drives. It is particularly suitable for rock products plants, oil field work, grain mills, excavators and other similar installations where quantities of abrasive materials may be present in the air. Write for bulletin S-500-B36.

## Sperry-Sun Exhibit

In charge of the Sperry-Sun Well Surveying Co. exhibit at the Houston Oil Show, booths 544-546, will be the following: G. L. Kothny, vice president and general manager; R. L. Marston, regional manager; R. S. Hyer, district manager, and J. P. Klep, sales engineer.

The following products will be shown:

SYFO Clinograph: A new type of "Go-Devil" Protective Casing which has been successfully used in "Go-Deviling" SYFO down to the depth of 12,500 feet, obtaining the record of inclination in a short space of time.

H-K Magnetic Inside Single Shot: This instrument has protective casings of 1 11/16", 1¾" and 2" diameter, and, therefore, can be lowered inside the drill pipe and extended below the bit when making readings for direction and inclination when using a removable core barrel. This instrument can also be used in an open hole in which case it is desirable to use a protective casing of 3½" O.D., which is available for this instrument.

H-K Inclinometer: This instrument gives accurate inclinometer readings to 1/10th of a degree or better. The instrument is self-checking, and it will not make a satisfactory record unless at rest at the depth at which the record is being sought. The instrument can be "Go-Deviled", thereby obtaining inclination records in a short space of time, the makers say.

Magnetic Method of Orientation of Drilling Tools: A new and accurate method of orientating drilling tools will be demonstrated. It consists of checking the orientation of the tool by means of two small magnets inserted in a sub or drill collar in the same plane as the drilling tool, and by lowering a single shot instrument to a point where the compass of the instrument is opposite the magnets in the sub, thereby obtaining record of the direction at which the tool or whipstock is set in the hole.

B. (Lou) Bronzan Harley Craig

Paul Diemer Bob Schmidt H. H. (Pete) Peters

## Technical Oil Tools Personnel Changes

Bob Schmidt, a newcomer to the Technical Oil Tool Co. will headquarter in Odessa to serve the West Texas and New Mexico territory. Schmidt replaces H. H. (Pete) Peters who has been transferred to California as representative in the Los Angeles Basin and Coastal fields.

Paul Diemer, of the same organization, will make his headquarters in Corpus Christi, Texas, as the first full-time representative of the Technical Oil Tool Co. in the South Texas area.

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## Baash-Ross Tool Co. Announces Two Advances

B. (Lou) Bronzan, former assistant sales manager of the Baash-Ross Tool Co. has been appointed sales manager of the company. Mr. Bronzan, who started with the company 10 years ago in the production department, will have complete charge of all of the sales activities, both domestic and export. His headquarters will be at Los Angeles.

Harley J. Craig, for 5 years with the Baash-Ross Tool Co. has recently been made general manager of their Mid-Continent division with headquarters in Houston.

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## Volumetric Pressure Gauge New Taylor Instrument

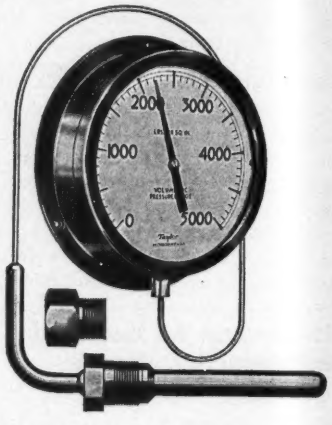
The maintenance of proper pressure on mud pump service cannot be overemphasized. Accurate mud pump pressure measurement enables the driller to maintain maximum drilling efficiency by adjusting the pump pressure to the formation encountered and the type of bit used. Furthermore, expensive "fishing" and repair jobs can be reduced to a minimum because formation changes, pump failures, twist-offs, and loss of circulation are indicated by pressure changes.

Invaluable to the operator who wants an inexpensive, accurate and rugged means for pressure measurement are the new Indicating and Recording Volumetric Pressure Gauges introduced by the Taylor Instrument Co., of Rochester, New York.

Employing a closed system very similar to a temperature tube system, the pressure sensitive element is in direct contact with the circulating fluid. Consequently, the measuring system is instantly responsive to every pressure variation. There are no pressure taps to clog, no diaphragms to wear out. Mud cannot get into the instrument mechanism.

An inbuilt feature of this new Taylor instrument damps out pump pulsations, yet accurately measures sustained pressure changes. This means greater ease of reading and prolonged life for the instrument.

Temperature variations of the fluid have no appreciable effect on the accuracy of measurement due to a permanent built-in feature of the pressure sensitive element. Changes in temperature along the connecting tubing are




counteracted by the use of Taylor Accuratus temperature-compensated tubing, a patented Taylor product.

The Recording Volumetric Pressure Gauge aids engineers in determining the most efficient pressure for the day's operation plus giving a permanent record of the efficiency of both pump equipment and operators. The Indicating Volumetric Pressure Gauge has an 8" silvered metal dial with bold black numerals and graduations which assure easy reading from across the derrick floor. Both types are ruggedly constructed for heavy, permanent, service and are easily installed. Standard range is 0 to 5000 lbs.

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## Tubbs Cordage Booklet Comprehensive Rope History

"The Story of Rope", just issued by the Tubbs Cordage Co., is reported to be the most complete coverage of the history and development of cordage making that any manufacturer has attempted.

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You are reading the Pacific Coast oil men's home paper.

## duPont Introduces New Blasting Agent

A new blasting agent, "Nitramon" S, for seismic prospecting by the reflection method has just been announced by E. I. du Pont de Nemours & Co. It is packed in metal cans with ends which permit joining of a number of separate units before loading in the blast or shot holes.

"The blasting agent is much safer to handle and use than gelatin dynamites normally used for reflection shooting," the company's announcement says. "It is not an explosive in the accepted sense since it cannot be detonated by the strongest commercial detonators, by Cordeau or Primacord detonating fuse, by flame, or by heavy blows which is particularly important for the safety of field crews. Even the impact of a rifle bullet will not detonate the charge.

"As the separate cans may be joined together to form a single unit column of any desired weight, 'Nitramon' S is easier to handle than ordinary gelatin. As long as the sealed cans remain intact, the blasting agent retains its maximum blasting efficiency under water. Since it is packed in sealed cans, handling becomes a clean operation, with no contact with any of the contents.

"The new blasting agent is non-freezing under any temperatures, and will usually be more economical to use than the gelatin dynamites used in this work," the company says.

The strength and velocity of the agent is approximately equal to that of gelatins normally employed in geophysical prospecting.

"Nitramon" S is packed in two sizes: 2 inch diameter by 1 pound and 2½ inch diameter by 1¼ pounds. The former is 6½ inches long, the latter 6¼ inches. Both size cans are packed in cases of 50 pounds net weight.

Special primers, also packed in cans, must be used with each charge to initiate the "Nitramon" S assembly. The explosive in these primers can be detonated by a blasting cap but is insensitive to friction or even the impact of a rifle bullet. They are prepared for use by removing a protective shield, inserting an electric blasting cap in a well provided in the can, anchoring the leg wires, and replacing the protective shield. The primers are manufactured only in the 2 inch diameter by 6½ inch lengths.

The strength of the primer is equivalent to that of one pound of 60% gelatin, and the primer alone should be used for shots requiring only one pound of explosive.

Field tests show that comparable seismograph records are obtained when a given weight of 60% gelatin is replaced with an equal or slightly less weight of "Nitramon" S and primer. Using one 2 inch diameter primer with each charge of "Nitramon" S, the following table shows the number of cans of the blasting agent required to duplicate the varying charges of 60% gelatin:

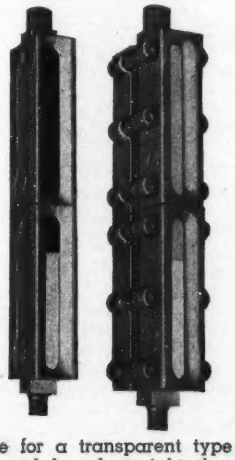
| 2" Diameter No. | "Nitramon" S Total | 2½" Diameter No. | "Nitramon" S Total |
|---|---|---|---|
| lbs. 60% Gelatin | Cans "Nitramon" S with Primer | Cans "Nitramon" S with Primer | Weight |
| 1 | 0 1 lb. | | |
| 2 | 1 2 lb. | | |
| 3 | 2 3 lb. | | |
| 4 | 3 4 lb. | | |
| 5 | 4 5 lb. | 3 | 4¾ lbs. |
| 7½ | 6 7 lb. | 5 | 7¼ lbs. |
| 10 | 9 10 lb. | 7 | 9¾ lbs. |
| 15 | 14 15 lb. | 11 | 14¾ lbs. |
| 20 | 19 20 lb. | 15 | 19¾ lbs. |

In field tests the primer can and protective shield for the electric blasting cap have withstood more pressure than is applied by three men poling a charge in a shot hole. Laboratory tests have shown that pressures greatly in excess of this can be applied without detonating the primer unit, an important safety advantage.

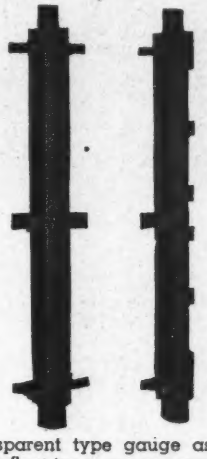
The primers are high explosives and must be stored in a dynamite magazine and treated as a high explosive. While "Nitramon" S is not an explosive in the accepted sense, since it will not detonate as easily as dynamite, it can be detonated and for this reason it should be handled as a high explosive to insure against any possibility of wilful damage.

## Inferno Introduces "Tailor Made" Gauge

A new gauge for separators, gasoline plants and refineries, with a one-piece fluid channel any length up to ten feet is announced by The Inferno Co., Shreveport, Louisiana. Bulletin No. 20 is available on the subject. This new "tailor made" gauge can be either reflex or transparent, and is manufactured only on order and to specifications as to over-all length and the threads desired on the ends. Quick operating clamps are used to hold the glasses in place, designed so that a glass cannot be accidently broken by applying too much pressure on any one screw when installation is made.



Left: Core for a transparent type gauge, with channel bored straight through the bar of metal, and with lugs welded between the apertures to guide the glasses and clamps into correct position. In this case the customer ordered a male thread on one end and a female thread on the other. Right: Core ready for reflex type gauge, with apertures cut through into the channel on one side only.



Left: Transparent type gauge assembled. Right: Reflex type gauge assembled.

The one-piece core for this new gauge is made of navy bronze, steel or stainless steel, depending on pressures, temperatures and corrosive conditions. The core is bored from a solid bar of metal, and apertures are then cut through into this channel over which gaskets, glasses and clamps fit snugly. Only one inch intervenes between visible sections.

The gauge conforms with A.S.M.E., A.P.I. and all other known requirements for equipment of this nature.

## Tide Water Associated Officials Given New Posts

B. I. Graves, a director and vice president of Tide Water Associated Oil Co., was elected a director and vice president of Western Minerals Co. and Pioneer Midway Oil Co. Consolidated, and a director of Sterling Oil & Development Co., at the annual meetings of stockholders of those companies.

L. C. Decius, a vice president of Tide Water Associated Oil Co., was elected a director and vice president of West Coast Oil Co. and Pantheon Oil Co., and a vice president of Sterling Oil & Development Co. at the annual meetings of those companies.

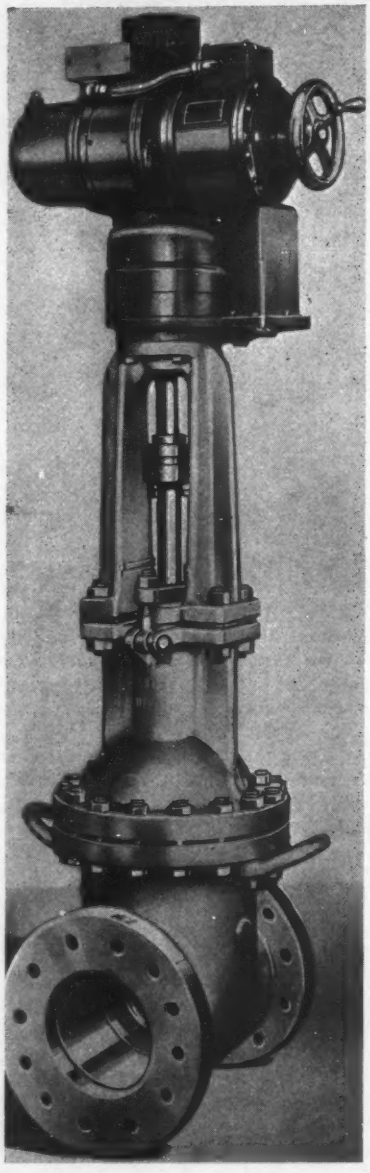
The five companies named, all operating on the Pacific Coast, are subsidiaries of the Tide Water Associated Oil Co.

All other directors and officers of the subsidiary companies named were re-elected.

## Barnes Hydraulic Actuators Have Important Features

A Barnes Multi-Power Hydraulic Valve Actuator provides a most positive device for opening and closing operations on globe, gate, butterfly, rotary plug and many other similar applications, say the makers, W. F. and John Barnes Co., Rockford, Ill.

The range of capacity is practically unlimited; standard or special sizes being available for almost any requirement. Open and closed applications and



positioning control are available by automatic or manual means and by remote control if desired.

Specifications requiring explosion-proof and weather-proof construction can be met and manual emergency operation is supplied as a standard feature.

The design is extremely compact. It affords maximum efficiency, having a minimum of parts subject to wear and maintenance, and its unique action precludes severe usage of the seats of the valve structure. Outstanding among its many advantages is the Barnes Gear Pump and Circuit with patented exclusive features which produce desired pressures to more than 1000 pounds per square inch without crushing or heating the fluid.

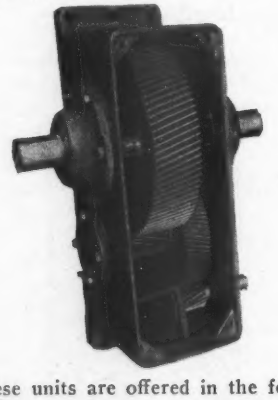
The Barnes Actuator provides a positively controlled travel at all times and under all conditions. Due to compensating design, it fully conforms to changes caused by a variable temperature of the valve proper. Further, on valve structures which require positive locking in any position, such locking is available. Design of the Barnes Actuator precludes the common hammer blow required to lift the valve from its seat, eliminating the consequent shock load and assuring longer life to the entire structure.

Easy to install on existing equipment and readily adapted to any make of valve, the Barnes Hydraulic Valve Actuator is being recognized in industry as an outstanding development in power valve actuation. Complete information may be obtained from Automatic Temperature Control Co., Inc., 34 East Logan St., Philadelphia, sales representatives.

Pacific Scientific Co., 1206 Maple Ave., Los Angeles, are Pacific Coast representatives. The Factory representative is C. Howard Eden, 1031 S. Broadway, Los Angeles.

## Foote Bros. Shallow Well Helical Pumping Reducers

The Foote Bros. Gear and Machine Corp., Chicago, Ill., have recently added to their line of IXL oil well pumping reducers a series of double reduction helical units for pumping individual shallow wells.



These units are offered in the following sizes:

9 DLO-3.5 HP capacity. Peak torque at 20 strokes per minute 17,000 inch-pounds.

10 DLO-5 HP capacity. Peak torque at 20 strokes per minute 20,000 inch-pounds.

11 DLO-7.5 HP capacity. Peak torque at 20 strokes per minute 34,000 inch-pounds.

Cases are constructed of semi-steel, treated to prevent flaking. Gears are low helix angle helicals of alloy cast iron. The helix is opposed on high and intermediate sets to absorb the reduced thrust loads. Pinions are heat treated alloy steel; with Timken roller bearings used on both shafts.

These units are very compact in construction, have been carefully designed, and present a pleasing appearance. Each reducer conforms in every way to the high standards of all IXL products.

## Youngstown Announce New Special Representative

The Youngstown Sheet and Tube Co., Youngstown, Ohio, announce the appointment of Harvey L. Miller as Special Representative in connection with the sale of Oil Well Tubular Goods in the Mid-Continent Oil Fields, with headquarters in Dallas, according to W. E. Watson, vice president.

## Cleveland Trencher Co. Names Smith Booth Usher Co.

Smith Booth Usher Co. announce their appointment by the Cleveland Trencher Co. as distributors for the Cleveland line including trenchers, ditchers, backfillers, pipe layers, tampers and trailers for Southern California, Southern Nevada, and Arizona.

Cleveland wheel type trenchers are made in several sizes capable of digging 10½" to 23½" width and 5 feet depth, while the ladder types will dig from 12 inches to 30 inches width with a maximum of 12 feet depth. These two machines are mounted on crawlers and driven by gasoline engines. The pipe layers and backfiller combination machine is made in one size with a lifting capacity of 10,000 pounds and equipped with a 50 HP gasoline engine and backfiller scraper. A tamper-backfiller combination machine is also available for tamping and backfilling operations. Both these two machines are gasoline engine driven and mounted on crawlers. Trailers are available for all their machines so that they may be moved rapidly from job to job.

The Cleveland line of trenchers offers the pipeline and ditcher operators a machine for nearly every purpose, compact, mobile, of rugged construction, and with ample power for the hardest service and tough going.

Machines are carried in stock and anyone interested is invited to stop in at Smith Booth Usher's display rooms and look the machines over any time.

Smith Booth Usher Co. is located in Los Angeles at 2001 Santa Fe Ave.

## Trico Gas Line Completed

Completion of a gathering line to the main transmission lines of Pacific Gas and Electric Co. provides the first outlet available to Trico gas field operators. Located 37 miles northwest of Bakersfield on the Kern county-Kings county line, the field has been shut in pending the completion. There are at present 9 "gassers" in the structure, producing from the San Joaquin Clays of the Pleistocene epoch, the productive horizon of all Central Valley gas fields. The most recent completion in the area was Standard Oil Co. M&L No. 1 in sec. 3, 25-23, which came in for an estimated 7,520,000 cu. ft. per day and was shut in immediately.

Frank M. Beeson, president and general manager, Beeson Engineering Co., points out some of the features of GM's new "streamliner miniatures", industrial engines designed in replica of GM's more famous 1600 h.p. railroad power plant, to Carl F. Chandler, newly appointed oilfield sales representative for Beeson for Southern California, Arizona and Southern Nevada.

## General Motors Appoints Beeson Engineering Co.

General Motors Corp., in announcing the appointment of the Beeson Engineering Co. of Los Angeles as distributors in Southern California, Arizona and Southern Nevada, of the full General Motors line of Diesel engines, has released one of the most important bits of news of the month in oilfield equipment circles.

Frank M. Beeson, president of the Beeson Engineering Co., needs no introduction to members of the petroleum industry. He began his career in the Diesel engine field in 1911 when he was sales representative for the Alamo Manufacturing Co. of Hillsdale, Mich. He came to California in 1922 and was long a sales engineer for Jenkins Cracking Units. The Beeson Engineering Co. was formed in 1930 and operated from 2501 East 52nd St., Los Angeles until the recent removal of its headquarters, general offices and service facilities to 333 West Washington Blvd.

The new headquarters consists of general offices, showrooms, warehouse, shops and service departments completely equipped to service or rebuild Diesel engines of any model or size that might be used in industrial installations. Available warehouse space in the new headquarters and the old Vernon plant exceeds 37,500 square feet.

The company has installed Diesel equipment and electrical generator facilities at their new headquarters and will be independent of public utilities for power for heating, lighting and industrial application in its shops and service departments.

Beeson has organized a complete and capable operating and executive personnel. Carl F. Chandler, former sales manager for Frazier-Wright and Lycoming engines in Southern California and later district manager for the MacMillan Petroleum Co. in Ohio and Indiana, will be in charge of oilfield sales for the new Diesel organization. His broad experience in all local fields and wide acquaintance among oil men makes his selection a happy one.

Executives of the company, aside from Frank M. Beeson, president, include Paul Beeson, sales manager; Daniel Coyle, chief engineer, and Donald Beeson, the president's younger son, in charge of service and maintenance department. Mr. Coyle, prior to his present connection, was in charge of engineering maintenance for the State of California and was previously identified with the Pacific Gas and Electric Co. of San Francisco.

The Diesel industrial units to be handled by the Beeson Engineering Co. are patterned after the big 1600 h.p., Diesel plants built by General Motors for use in some of the finest and most famous streamline trains of the nation, and are, in fact, really small replicas of their famous parents. The success and remarkable economy of the railroad power units prompted the development of the smaller replicas as packaged power units suitable for a broad field of applications in various industrial fields. In fact, the 1600 h.p., "Streamliner" full Diesel model with some changes is readily convertible for oil field drilling, weighing only 50,000 pounds; while the 12 cylinder Diesel electric unit weighs but 42,000 pounds. Comparing these giants with the "baby" in the General Motors line, a Diesel package power unit delivering 15 h.p., gives some idea of the line on which General Motors spent upwards of $10,000,000.00 in research, testing and development before a single unit was sold.

This, too, gives an idea of the extremely broad range of power available to the industrial user. Oilfield units for pumping will range from 15 to 90 h.p., while drilling engines can be had in almost any size and power range. A feature which will probably have a ready appeal to oilfield operators is the availability of Diesel units for changing over to Diesel fuel practically any equipment now operated by gas engines.

General Motors now has in operation in the United States more Diesel horsepower than all other types and makes of Diesel engines manufactured and it is significant to the public interest in this type of equipment that the Diesel division of the General Motors exhibit at the San Francisco fair is one of the most popular on Treasure Island.

Rounding out the Beeson organization and making service readily available at a number of different strategic points, sales and service facilities have been established in Bakersfield under the direction of E. R. Porter & Co. Branches will later be established in Phoenix and Las Vegas, Nevada, with later extensions of service facilities when necessary.

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## Tubbs Cordage Exhibit Draws World Fair Crowds

One of the exhibits that has been attracting unusual attention at the Golden Gate International Exposition on Treasure Island in San Francisco Bay is that of the Tubbs Cordage Co., pioneer rope manufacturers of the West.

This highly effective display, occupying over 60 feet of aisle space in the Palace of Mines, Metals and Machinery, is carried out with modern design and lighting effects and features actual rope making machinery in operation. There all day long crowds of interested spectators watch the yarn being spun and rope strands being laid into completed rope.

A background of colored photographs depict fibre scenes and the stages in fibre preparation up to the time it becomes rope yarn. Supplementing this, are constantly changing colored slides showing further scenes of rope making and the use of rope in industry.

Thousands of booklets and knot folders have been distributed by Tubbs Cordage Co. during the opening weeks of the Exposition to interested spectators who indicated interest in Tubbs well-known products.

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## Dowell District Offices Opened in Houston, Tex.

Dowell Incorporated, oil and gas well chemical service experts, announce the opening of district offices at 1209 Shell Bldg., Houston, Tex. Installed in the new offices are C. T. Young, district manager, and S. C. Morian, district engineer.

# Business and Professional Directory


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1127 Story Bldg.
Los Angeles, Calif.
Phone: TUcker 7530


## Oil Men's Calendar

C.N.G.A. Meeting First Thurs. Each Month.

**April**

24-29—Oil-World Exposition, Inc., Houston, Tex.

26-28—American Institute of Mining & Metallurgical Engineers, Open Hearth Conference, Cleveland, Ohio.

**May**

3-5—Natural Gasoline Assn. of America, Tulsa, Okla.

9-11—American Institute of Chemical Engineers, Akron, Ohio.

15-18—AMERICAN PETROLEUM INSTITUTE, 9th Mid-Year Meeting, Roosevelt Hotel, New Orleans, La.

21-25—National Assn. of Purchasing Agents, Annual Convention, (Oil Company Buyers' Group), Fairmont Hotel, San Francisco, Calif.

22-June 8—World Automotive Engineering Congress, sponsored by S.A.E. for New York (May 22-26), Indianapolis (May 30), Detroit (May 31-June 2), San Francisco (June 6-8).

## California Crude Oil Production

Three Weeks Ended April 15, 1939

| | April Daily Quota | Average Daily Production | Excess |
|---|---|---|---|
| **San Joaquin Valley** | | | |
| Belridge—North | 13,415 | 12,001 | *1,414 |
| Belridge—South | 1,905 | 1,144 | *761 |
| Buena Vista | 16,175 | 16,581 | 406 |
| Canal | 4,190 | 4,537 | 347 |
| Coalinga-East (Eocene) | 3,778 | 4,487 | 709 |
| Coalinga—East-West | 15,427 | 7,006 | *8,421 |
| Edison | 2,335 | 2,437 | 102 |
| Elk Hills | 7,255 | 10,039 | 2,784 |
| Fruitvale | 6,480 | 6,871 | 391 |
| Greeley | 1,890 | 2,253 | 363 |
| Kern Front | 7,380 | 7,505 | 125 |
| Kern River | 5,760 | 2,564 | *3,196 |
| Kettleman No. Dome | 52,145 | 55,267 | 3,122 |
| Lost Hills | 3,980 | 3,317 | *663 |
| McKittrick | 3,685 | 3,507 | *178 |
| Midway | 39,405 | 35,900 | *3,505 |
| Mount Poso | 12,420 | 13,487 | 1,067 |
| Mountain View | 7,965 | 9,007 | 1,042 |
| Rio Bravo | 6,720 | 8,085 | 1,365 |
| Round Mt. and Coffee Canyon | 10,520 | 10,990 | 470 |
| Ten Section | 8,730 | 9,332 | 602 |
| Wasco | 820 | 783 | *37 |
| Other Fields | 2,465 | 2,650 | 185 |
| TOTAL | 234,845 | 229,750 | *5,095 |
| **Coastal Counties** | | | |
| Elwood | 4,110 | 4,496 | 386 |
| Rincon | 2,845 | 3,103 | 258 |
| Santa Maria | 5,825 | 3,673 | *2,152 |
| Gato Ridge | 1,930 | 2,647 | 717 |
| Santa Maria Valley | 18,215 | 10,674 | *7,541 |
| Santa Paula-Newhall | 5,320 | 5,423 | 103 |
| Ventura Avenue | 29,670 | 33,281 | 3,611 |
| Other Fields | 5,405 | 5,606 | 201 |
| TOTAL | 73,320 | 68,903 | *4,417 |
| **Los Angeles Basin** | | | |
| Alamitos-Seal Beach | 6,760 | 7,941 | 1,181 |
| Brea-Olinda | 8,170 | 5,698 | *2,472 |
| Coyote—East | 2,690 | 2,470 | *220 |
| Coyote—West | 7,405 | 7,762 | 357 |
| Dominguez | 17,525 | 21,479 | 3,954 |
| El Segundo | 3,215 | 3,709 | 494 |
| Huntington Beach—New and Old | 24,085 | 28,991 | 4,906 |
| Inglewood | 11,810 | 11,736 | *74 |
| Long Beach | 40,015 | 48,765 | 8,750 |
| Montebello | 5,772 | 6,020 | 248 |
| Montebello-West End | 5,243 | 9,374 | 4,131 |
| Playa del Rey | 4,770 | 5,398 | 628 |
| Richfield | 7,235 | 7,931 | 696 |
| Rosecrans-Athens | 9,465 | 14,872 | 5,407 |
| Santa Fe Springs | 25,810 | 28,075 | 2,265 |
| Torrance | 5,684 | 5,666 | *18 |
| Torrance "34" and "D & B" | 12,916 | 15,976 | 3,060 |
| Wilmington | 66,225 | 88,175 | 21,950 |
| Other Fields | 3,020 | 3,521 | 501 |
| TOTAL | 267,815 | 323,559 | 55,744 |
| STATE TOTAL | 575,980 | 622,212 | 46,232 |

*—Shortage.